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# ***JPRS Report***

# **Science & Technology**

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***USSR: Electronics &  
Electrical Engineering***

6 AUGUST 1987

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## SCIENCE &amp; TECHNOLOGY

## USSR: ELECTRONICS &amp; ELECTRICAL ENGINEERING

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/9835



UDC 621.372.54:519.21

MODEL OF NOISE IN TEST SIGNAL PASSING THROUGH DIGITAL SIGNAL PROCESSING CHANNELS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 9, Sep 86 (manuscript received after revision 9 Dec 85) pp 18-23

[Article by Ya.P. Dragan and B.I. Yavorskiy]

[Abstract] A model of noise in a digital test is constructed adequately describing not only sinusoidal or other deterministic signals with periodically varying slope but also random signals with periodically probability characteristics, such signals being used for accuracy testing or design optimization of special computer system components like digital band-pass filters. The model, derived from conventional quantization of a continuous signal, is a periodically correlated random sequence. It is a stationary one such as a discrete white noise in the case of a high discretization frequency and a nonstationary one in the case of a low or arbitrary discretization frequency, but is not applicable where strong nonlinearities, narrow limits, wide "dead" zones" exist. Figures 1; tables 1; references 11: 9 Russian, 2 Western (1 in Russian translation).

2415/9835  
CSO: 1860/74

UDC 681.3.01:621.372.5

CHOICE OF DIRECT PROGRAMMING STRUCTURE OF DIGITAL FILTERS WITH RESPECT TO SIGNAL/NOISE CRITERIA

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 11, Nov 86 (manuscript received 16 Oct 85) pp 41-46

[Article by A.I. Ivanov and D.Yu. Bukhvostov, Ufimskiy Aviation Institute imeni Sergo Ordzhonikidze]

[Abstract] The object of this article is to show that: 1) For either of two basic structures for direct programming of a random recursive digital

filter, an amplification factor exists which assures a minimum noise/signal ratio within the limits of the given structure; and 2) For an input signal of the white noise type, one of the two basic structures for direct programming always provides for a better noise/signal ratio as compared with the other. Figures 3; references 2: 1 Russian, 1 Western (in Russian translation).

6415/9835  
CSO: 1860/82

UDC 621.391.019.4

DETECTION OF SIGNALS SUBMERGED IN BACKGROUND INTERFERENCE IN CASE OF PARTIAL  
A PRIORI INDETERMINACY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 29 Oct 84) pp 1541-1546

[Article by A.N. Dmitriyenko]

[Abstract] Decision rules are established and corresponding algorithms are constructed for detection of deterministic or random signals submerged in background interference with partially unknown parameters, typically an unknown distribution. The general form of decision rules is particularized for special cases such as Gaussian interference or an otherwise exponentially distributed one, optimum decision rules for the two extreme cases of complete a priori determinacy or indeterminacy being also applicable here with some loss of efficiency. As an example is estimated the efficiency of a decision rule for an independent Gaussian complex sample with zero mathematical expectation and finite dispersion of only some a priori known parameters. Figures 1; references 6: 5 Russian, 1 Western (in Russian translation).

2415/9835  
CSO: 1860/70

UDC 621.396.96:621.391.1

SYNTHESIS OF SYSTEMS FOR ADAPTIVE PROCESSING OF SIGNALS UNDER TRANSIENT  
CONDITIONS ON BASIS OF PROBABILITY CRITERIA

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 21 Dec 83) pp 1555-1562

[Article by D.I. Popov and S.V. Guskov]

[Abstract] The method of state variables is applied to synthesis of systems for interperiod processing of signals with passive interference under transient conditions and a priori parametric indeterminacy, this method

yielding an adequate description of recursive band-reject filter array in the time domain. The solution to the corresponding difference equation of state in standard matrix form, with known beginning of a sample, is a vector which depends on the filter parameters as well as on the initial-state vector. An invariable filter structure is synthesized first, on the basis of probability criteria, whereupon the correlation matrix of the filter output is analyzed. Adaptive tuning of the filter structure by optimization of the weight coefficients in the filter array is then found to maximally increase the processing efficiency by shortening the transient time. The results of a numerical experiment with an N31-R32 filter confirm this conclusion. Figures 3; tables 1; references 6: 4 Russian, 2 Western (1 in Russian translation).

2415/9835  
CSO: 1860/70

UDC 621.396.669.8.01

#### SYNTHESIS OF HIGH-SPEED INTERFERENCE AUTOCOMPENSATOR WITH CORRELATION FEEDBACK

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 5 Sep 84) pp 1571-1577

[Article by V.V. Savchenko]

[Abstract] An iterative second-order algorithm on the basis of stochastic approximation is constructed for high-speed interperiod automatic compensation of passive interference by means of a transversal, nonrecursive in the digital version, band-reject filter array of N-th order. Adaptive optimization of the weight vector with the aid of correlation feedback increases both the interference immunity and convergence rate when the input signal-to-interference ratio is low. A numerical example demonstrates the advantage of this algorithm over gradiental ones, especially under nonstationary conditions. Figures 5; references 15: 11 Russian, 4 Western (2 in Russian translation).

2415/9835  
CSO: 1860/70

## ASYMPTOTICALLY OPTIMUM ALGORITHMS OF NONLINEAR FILTRATION FOR PROBLEMS OF DIGITAL SIGNAL PROCESSING

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 19 Sep 83) pp 1578-1584

[Article by V.N. Kharisov and Yu.N. Kirilenko]

[Abstract] Exact and approximate algorithms of digital nonlinear filtration, specifically by an analog-to-digital converter with time discretization and level quantization, are evaluated relative to algorithms of analog nonlinear filtration. Recognizing that the Markov theory of optimal filtration remains valid here, an asymptotically optimum algorithm is constructed by the Stratonovich method and its efficiency, lower than that of the optimum algorithm because of higher input noise power, is estimated including the additional quantization noise. This loss of efficiency can be minimized by matching the threshold of the analog-to-digital converter to the noise level. Figures 3; references 16: 11 Russian, 5 Western (1 in Russian translation).

2415/9835

CSO: 1860/70

## COMPARING OPTIMUM ANALOG AND ASYMPTOTICALLY OPTIMUM DIGITAL ALGORITHMS OF SIGNAL RECEPTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 3 May 84) pp 1585-1589

[Article by V.N. Kharisov and Yu.N. Kirilenko]

[Abstract] Reception of a useful signal with a normally distributed random parameter in the presence of additive interference in the form of a wideband Gaussian white noise is considered, for a comparative evaluation of optimum analog and asymptotically optimum digital algorithms of signal processing with respect to the output signal-to-noise ratio. Digital processing is assumed to involve quantization into only two levels, at the limits of allowable signal distortion. A digital algorithm of automatic phase control is then constructed on the basis of binary quantization for a useful signal  $s(t, \phi)$  with the phase  $\phi$  varying as a random function of time  $t$ . The loss in this algorithm approaches the theoretical limit  $1/2\pi$ , even in this worse case of binary quantization and with the signal-to-noise ratio in the readout  $\rho^2 < 1$ , but will decrease when the number of quantization levels is increased and will dip to a minimum at some higher signal-to-noise ratio  $1 < \rho^2 < 2$  in the readout. An increase of this ratio in this case is accompanied by a buildup of quantization error and, at the same time, by a more precise



fixation of instants of zero-threshold crossovers tending respectively to increase and decrease the loss. Increasing the discretization frequency strengthens the favorable latter effect. Figures 3; references 11: 9 Russian, 2 Western (1 in Russian translation).

2415/9835  
CSO: 1860/70

UDC 519.246

#### EFFICIENCY OF ADAPTIVE SPACE PROCESSING OF SIGNALS WITH TIME CORRELATION OF MONITORING SAMPLES

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 26 Mar 86) pp 60-63

[Article by D.I. Lekhovitskiy and I.D. Rakov]

[Abstract] Two methods of digital adaptive space processing of signals with Gaussian background interference are compared, one involving inversion of the maximally likely estimates of the correlation matrix or their regularized variants and one using a quasi-optimum but simpler estimation algorithm. An analysis of both in the case of a hypersymmetric correlation matrix reveals that time correlation of the monitoring vectors decreases the processing efficiency to an extent depending on the correlation coefficient and on the form of the time correlation function, while it doubles the adaptation speed. Numerical experiments verifying this conclusion were made with a linear antenna array of  $M = 20$  equidistant elements, first with  $K \geq M$  and then with  $K \geq 1/2M$  monitoring interference vectors. The authors thank V.V. Salamatin for assistance in mathematical modeling. Figures 4; references 10: 7 Russian, 3 Western.

2415/9835  
CSO: 1860/67

UDC 621.391.244

#### SELECTION OF SAMPLING MODE FOR DISCRETE PROCESSING OF SIGNALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE in Russian Vol 29, No 10, Oct 86 (manuscript received 9 Jan 86) pp 50-54

[Article by A.K. Mikelson, Institute of Electronics and Computer Engineering, LaSSR Academy of Sciences]

[Abstract] Conversion of an analog signal into a sequence of readings is considered, first by periodic discretization with "jitter" when the Kotelnikov

theorem is satisfied and then by stochastic discretization resulting either in a point distribution with limited aftereffect or in a Poisson distribution. These methods are analyzed for accuracy and its relation to the ratio of variance to discretization step, whereupon their relative merits are defined depending on application and performance requirements. References 5: 4 Russian, 1 Western (in Russian translation).

2415/9835

CSO: 1860/63

BISTATIC RADAR USING COSMIC RADIO EMISSIONS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received after revision 24 Dec 85)  
pp 871-877

[Article by A.G. Pavelyev, and A.I. Kucheryavenkov, USSR Academy of Sciences Institute of Radioengineering and Electronics]

[Abstract] A radar receiving system can be used to ascertain the correlation function of a radio emission from space and then analyze the parameters of the same signal reflected from the surface of a planet. Information derived from these two measurements reveals the distance between the antenna and planet's surface, the surface layer density, its layered structure and other features. The angular size of the portion of the emission source used for the radar sensing can also be determined as a function of the wavelength and distance to the planet. This in turn enables an analytical correlation determination of the distribution of the emission intensity over the celestial sphere. This paper is a mathematical demonstration of the feasibility of this approach. The feasibility depends on the anticipated signal to noise ratio; it is shown that the ratio of the useful signal (at the correlation function maximum) to the noise fluctuations at the correlator output (with respect to power) is directly proportional to the ratio of the square of the wavelength to the altitude of the observing satellite with the antenna. This indicates that the sensing of the surface layers is most promising at low frequencies where the antenna altitude is commensurate with the wavelength. The correlation analysis is also effective in the case when the average emission temperature is much greater than the background temperature averaged over the celestial sphere, a condition met by the kilometric emissions of the earth and such cosmic sources as Jupiter and Saturn and the Sun. No system designs are noted in this theoretical feasibility study. Figures 1; references 6: 4 Russian, 2 Western (1 in Russian translation).

8225/9835  
CSO: 1860/42

## POSSIBILITIES OF USING COSMIC RADIATION SOURCES FOR LUNAR AND PLANETARY RESEARCH

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received after revision 25 Nov 85) pp 1620-1626

[Article by N.A. Armand, A.G. Pavelyev, A.I. Kucheryavenkov, and D.Ya. Shtern]

[Abstract] Following a review of problems involved in lunar and planetary research as well as of the state of the art, use of kilometric-wave cosmic radiation emitted by Earth for probing the Moon or a planet is examined and the design of a satellite radar system for this purpose is outlined. The feasibility is based on the radiation pattern and its frequency characteristic. The performance of such a radar system, with a satellite orbiting around the target, is dictated by both topology and environment (plasmosphere) of the target determining the reach of cosmic radio waves. Several variants of such a radar system are possible, with the satellite carrying either a single antenna or separate antennas for pickup of the signal from Earth and the signal reflected by the target, on the basis of celestial geometry and signal propagation characteristics as well as of the energy relations in space which determine the signal-to-noise ratio and thus the signal power requirements. Data based on probing the Moon, Mercury, Venus, and Mars with radiation signals at the  $\lambda = 2$  km wavelength are helpful. Figures 3; tables 1; references 13: 8 Russian, 5 Western.

2415/9835

CSO: 1860/70



UDC 551.501.8

REMOTE SENSING OF ATMOSPHERE TEMPERATURE FROM SPECTRAL RADIOMETRIC MEASUREMENTS AT 5 MILLIMETER WAVELENGTH LINE

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 8, Aug 86 (manuscript received 14 Feb 85) pp 878-887

[Article by A.V. Troitskiy, Radiophysics Scientific Research Institute]

[..bstract] The altitude profile of the atmosphere's temperature can be determined from ground-based measurements of the atmospheric radio emissions using the slope of the 5 mm oxygen absorption line. The best trade-off between precision and speed is obtained using a combination method that provides for sensing at three frequencies covering an analysis band of about 2 GHz at two different angles. This paper defines the requirements for the optimal sensing frequencies and angles in the troposphere for altitudes of 0 to 10 km. The optimal variant calls for thermal sensing measurements at angles of 0° and 75° and frequencies of 53.5, 54.4 and 55 GHz. The optimal receiving system at the 5 mm line must provide for multichannel reception of about 5 to 6 channels, a high sensitivity of about 0.5 K with the receiving bandwidth in each channel limited to less than 400 MHz, as well as a wide signal analysis bandwidth of greater than 2 GHz, a frequency stability of better than  $5 \cdot 10^{-4}$  with highly stable gain. A multichannel semiconductor radiometer developed by the Radiophysics Scientific Research Institute is described: a superheterodyne modulation type radiometer with a mixer at the input. A block diagram complements the description of its circuitry and data taken in Gorkiy in June 1983 and January-February 1984 are used to plot the temperature profiles at altitudes from 0 to 10 km. The author is grateful to V.A. Rassadovskiy for assisting with the measurements and G.N. Troitskaya for the computer work. Figures 6; tables 3; references 15: 12 Russian, 4 Western.

8225/9835  
CS0: 1860/42

# APPROXIMATION OF ANISOTROPICALLY CONDUCTIVE DISK IN PROBLEM OF IRRADIATION OF PLANAR FINITE SPIRAL (SYMMETRIC WAVE MODE)

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received 26 Mar 85) pp 947-956

[Article by V.P. Krivokhizha and K.P. Yatsuk, Kharkov State University]

[Abstract] Planar log-spiral antennas can be approximated by an infinite, anisotropically conducting plane when the currents reflected from the ends of the spiral are small enough to neglect. This is true of the asymmetric wave mode; however, when the size of the radiating ring is smaller than the overall antenna dimensions (always true in practice), the modelling of the spiral must take into account the reflected currents. This paper analyzes the disk model of a log-spiral antenna in the symmetric wave mode and rigorously considers the conditions at the edge of the disk. The problem of the symmetrical excitation of this helically conductive disk of finite size is solved in order to find the current distribution and the far-field emissions. A comparison of the resulting expressions with the approximations of an infinite, helically conductive plane shows the inadequacy of the latter model for planar log-spiral antennas. A Fortran program is used to numerically solve the system of integral equations by quadrature approximations (using DECOMP and SOLVE software) so as to determine the directional pattern. A note is made of an experimental check at low frequencies ( $1/10$  to  $1/5$  the resonant wavelength) confirming the theory, though no numerical details are given. Figures 3; references 13: 10 Russian, 3 Western (2 in Russian translation).

8225/9835  
CSO: 1860/42

# PRECISION OF RECONSTRUCTION OF RADIO BRIGHTNESS DISTRIBUTION OF EARTH'S SURFACE FOR OBSERVATIONS USING MILLS CROSS TYPE ANTENNA

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received 24 Dec 85) pp 966-969

[Article by D.V. Shannikov, Leningrad Polytechnical Institute]

[Abstract] Two mutually perpendicular linear antenna arrays (Mills cross) are designed so that a correlation pattern can be produced that is symmetric with respect to the orientation of the main lobe through the appropriate choice of the phase delay in one of the antenna channels. The phase centers of the two antennas must be brought close together in order to reduce the level of the first sidelobes of the correlation pattern, necessitating the

intersection of the antennas. The resulting gap in one of them produces an extended sidelobe in the directional pattern and an extended negative sidelobe in the correlation pattern. Since the integral of the correlation pattern is zero, the effort to reduce its sidelobes leads to the need to spread them over a large angular sector; it is desirable that all sidelobes be negative in this case so that the maximum share of the "correlation" power is concentrated in the main lobe. This paper analyzes the application of this antenna to the remote sensing of the radio-brightness temperature of the earth's surface in which the absolute value cannot be measured through correlation analyses, but only the deviation of the measured value from some average. The precision of the estimate of the measurement of this deviation is specified by using a statistical model for the radio-brightness relief of the surface. The expression derived for this relative deviation is checked experimentally by a radiometric system consisting of two linear slotted waveguide arrays coupled by a phase modulator as well as a radiometer, rotating stand and autorecorder. The correlation patterns in the two mutually perpendicular planes are graphed for the centimeter band. The test area was a section of the ground surface covered with grass with metal strips arranged chaotically on it. Good agreement is noted between the angular distribution of the radio-brightness measured by the correlation system and those predicted by theory. The precision of the determination of this brightness can be improved by extending the width of the region covered by the negative lobe of the correlation pattern while correspondingly reducing its level, which can be done by adding a certain portion of the signal from the entire line of the cross to the signal from its other section ahead of the phase modulator. Figures 3; references 5: 3 Russian, 2 Western (in Russian translation).

8225/9835

CSO: 1860/42

UDC 621.373.029.7

# DEPENDENCE OF ACCURACY OF VELOCITY MEASUREMENT WITH OPTICAL HOMODYNE RECEIVER ON ENTRANCE APERTURE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 9, Sep 86 (manuscript received after revision 22 Nov 85) pp 50-52

[Article by V.A. Chulyukov]

[Abstract] Velocity measurement with two waves interfering in the aperture of a photoreceiver, a plane monochromatic probing wave and a reference wave, is considered in the case of a rectilinearly moving target with a statistically uneven surface. The accuracy of such a measurement is estimated in terms of the signal-to-noise power ratio in the optical mixer. Since macroroughness is principally responsible for scattering of waves, the effect of microroughness being negligible, the Kirchhoff approximation is applicable here. Assuming a large or even infinitely large area

of the target surface in the field of vision, moreover, use is made of the solution to the problem of diffraction within the Fresnel region in the scalar approximation. Calculations on this basis yield the dependence of the normalized signal-to-noise power ratio on the radius of the entrance aperture, with the photoreceiver at various distances from the target. This ratio is found to oscillate between zero and successively smaller maxima, as the radius of the aperture increases from zero up, these maxima becoming smaller and shifting toward larger radii of the aperture with increasing distance from photoreceiver to target. The aperture must be decreased, therefore, to ensure maximum signal-to-noise ratio as that distance decreases. Figures 2; references 4: 3 Russian, 1 Western.

2415/9835

CSO: 1860/74

UDC 621.397

#### CHARACTERISTICS OF DISCONTINUITIES IN TRACKING BY DISSECTOR TELEVISION TRACKING SYSTEM WITH DYNAMIC KALMAN FILTER

Kiev IZVESTIYA VYSHHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 9, Sep 86 (manuscript received 4 Jul 85) pp 53-55

[Article by Yu.V. Martyshevskiy and V.I. Tislenko]

[Abstract] A dissector television for tracking luminous point targets by optical radar is considered, such a system performing usually under intricate background with weak contrast and low signal-to-noise ratio so that discontinuities in the tracking process are likely to occur. The statistical characteristics of such discontinuities, influencing the dispersion of estimates of target coordinates, are analyzed and evaluated by the probabilistic method. Since the transient component of the signal current is negligible in this case, the video signal at the dissector input is represented as the sum of the useful signal component and a stationary noise. The trajectory of dissector motion is represented as the sum of a quasi-deterministic displacement and a random one, both also functions of time. The optimum r.m.s. signal estimate within a finite time interval is calculated on this basis, assuming a Gaussian approximation of the a posteriori distribution with only linear terms of the Taylor series retained. The resulting equations for the estimate and for the dispersion of filtering errors determine the structure of the optimum dissector television tracking system with a micrograting, with the probability of discontinuity in tracking defined as the ratio of number of blank hits to total number of hits and the signal-to-noise ratio defined as the ration of signal amplitude to r.m.s. background noise level within a given frequency band. Calculations for such a system designed to operate according to the algorithm of a dynamic Kalman filter indicate that in tracking an object which moves across the photocathode at a velocity of 20-30 mm/s, with a signal-to-noise ratio  $S/N = 4$ , the probability of discontinuity will not



exceed 2.5%. Figures 3; references 6: 4 Russian, 2 Western (1 in Russian translation).

2415/9835

CSO: 1860/74

#### ANTENNA SYSTEM FOR COMMUNICATIONS THROUGH AMATEUR RADIO SATELLITES

Moscow RADIO in Russian No 9, Sep 86 pp 22-23

[Article by V. Glushinskiy, amateur callsign UW6MA, master of sport of the USSR, Rostov-on-Don]

[Abstract] The antenna system for amateur communications through satellites consists of a ground plane antenna with a center whip 4.96 m long, having four 5 m long counterpoise elements, an antenna switcher using three RFS-34 relays and a two-stage FET RF amplifier. A special design feature of the amplifier is the use of high-Q coils in the front end to attenuate interference when the amateur station transmitter operates on two meters. The amplified RF signal is fed to the receiver via an RK-75 coax cable, which is also used as the +12 V power supply line. This brief article provides both the circuit schematic and structural layout of the antenna and amplifier along with alignment and construction details. No performance specifications are given. Figures 3.

8225/9835

CSO: 1860/46

UDC 621.371.34

#### CHARACTERISTICS OF RADIO SIGNAL PROPAGATING THROUGH TROPOSPHERE WITH DIFFRACTION

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 6 Mar 85) pp 1481-1486

[Article by N.B. Chimitdorzhiev, D.D. Darizhapov, G.S. Zhamsuyeva, and D.Z. Tsydypov]

[Abstract] Propagation of radio signals beyond the horizon through the intermediate zone of commensurate diffraction and tropospheric scattering was studied in an experiment with continuous recording and measurement of fluctuations, the purpose being to diagnose the seasonal variations of their diurnal characteristics. The data on slow fluctuations reveal a close correlation with the seasonally varying gradient of the refractive index, its cycle in a severe continental climate being characterized by a larger maximum in winter and a smaller maximum in summer with a minimum in spring and a

minimum in autumn. From the standpoint of electromagnetic compatibility accordingly, winter is the least favorable period of the year for transmission of radio signal over regions with such a climate. The data on fast fluctuations reveal a wider fadeout range during the spring-summer-autumn period but longer fadeout periods in winter, which is in contrast to fluctuation characteristics of radio signals in a mild climate. Figures 5; references 11: 10 Russian, 1 Western.

2415/9835  
CSO: 1860/70

UDC 537.874.2/3.01

#### POLYFOCAL SYSTEMS AND METHOD OF MATCHED IMAGES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 28 Dec 84) pp 1507-1515

[Article by I.L. Vaaz and B.Ye. Kinber]

[Abstract] Design of unaberrational N-focal optics is considered, with zero aberration measure in all N directions within the scanning range as criterion. The principle is demonstrated on a bifocal system, with two bounded congruence sectors, and then extended up to a penta-focal system using the method of matched images rather than by reduction to bifocal systems. The initial state of such an optical system must be stipulated, first in terms of  $N^2$  nodal points representing N trajectories on N surfaces and then in terms of surface curvatures at each nodal point so as to satisfy three constraints: 1) each initial trajectory to have at least two terminal nodes, 2) each initial trajectory to be tangent to a caustic line in the intermediate ray field at a number of points odd or even depending on whether its two terminal nodes lie on the same side or on opposite sides of that line, 3) all segments of N caustic lines within a bounded congruence sector of ray fields  $(M, q-1)$  ( $M = 1, 2, \dots, N$  and  $1 \leq q \leq N-1$ ) to lie between or outside segments of surfaces  $q-1$  and  $q$ . The procedure is applied, for illustration, to the design of a symmetric trifocal system. Figures 4; references 4: 3 Russian, 1 Western.

2415/9835  
CSO: 1860/70

## QUASI-OPTIMUM ALGORITHM OF SPACE-TIME SIGNAL PROCESSING BY LARGE ADAPTIVE ANTENNA ARRAY

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 16 Apr 86) pp 7-12

[Article by V.N. Manzhos, V.N. Kokin, and N.I. Kamchatnyy]

[Abstract] Quasi-optimum adaptive space-time signal processing by a phased antenna array with large aperture is considered, such processing being simpler and more efficient than subdivision of the signal spectrum into intervals and use of multitap delay lines when the number of channels may become so high as to make processing in real time at high transmission rates hardly feasible. One such quasi-optimum adaptive algorithm, constructed for space-time signal processing by a receiver antenna consisting generally of  $L$  blocks with  $M$  elements in each, uses a priori data on the bearing of interference sources and is almost insensitive to delay of signals along their envelope within the antenna aperture. It has been stimulated on a computer, with an equidistant linear antenna array consisting of 4 blocks with 8 elements in each. The results confirm the expediency of this algorithm and indicate its applicability to active or passive multiposition radar, also the feasibility of waiving a priori data on the bearing of interference sources. Figures 3; references: 9 Russian.

2415/9835

CSO: 1860/68

## ACCURACY OF AZIMUTH OF MOVING TARGET MEASUREMENT BY RADAR WITH SYNTHESIZED APERTURE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 26 Mar 86) pp 18-21

[Article by A.T. Abrarov, V.N. Antipov, and G.S. Kondratenkov]

[Abstract] A radar with synthesized aperture is considered for measurement of the coordinates of a moving target, the attainable accuracy being dependent on the indeterminacy in the probing signal as well as that in the antenna aperture. The indeterminacy function with respect to three generally sought target coordinates (azimuth  $\Delta\theta$ , tangential velocity  $\Delta V_t$ , radial velocity  $\Delta V_r$ ) is calculated for a probing pulse signal returning with a phase shift, with the amplitude-phase distribution in the aperture of the real antenna taken into account. The attainable accuracy is then estimated in terms of the corresponding error dispersion and found to depend principally on the dimensions of the real antenna, on the aperture synthesization step

in the case of a stationary target. With regard to the tangential velocity, error dispersion and thus the attainable accuracy of measurement depend on the linear azimuth resolution and on the aperture synthesization step. With regard to the radial velocity, they depend on the forward velocity of the target and on the width of the antenna radiation pattern. Figures 3; references: 6 Russian.

2415/9835  
CSO: 1860/68

UDC 621.396.677.71

#### ELECTRICAL ADMITTANCE OF LONGITUDINAL SLOT IN ELLIPTICAL CYLINDER

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 10 Feb 86) pp 73-75

[Article by V.A. Kravtsov]

[Abstract] Expressions are derived for both self-admittance components, conductance and susceptance, of a longitudinal slot in an elliptical cylinder. A narrow slot is considered, allowing to assume a sinusoidal voltage distribution. Calculations by the method of induced magnetomotive forces in the appropriate system of cylindrical coordinates  $(r, \phi, z)$  yield both components  $g_{11}$  and  $b_{11}$  as functions of the angular coordinate  $\phi$ . As the elliptical cylinder degenerates into a circular one, the angular Mathieu functions in these expressions become trigonometric ones and derivatives of the radial Mathieu functions become derivatives of Bessel or Neumann functions. Numerical calculations have been made for a unilateral longitudinal half-wavelength wide slot in elliptical cylinders with various ratios of ellipse parameters and slot length to wavelength. Figures 3; references 4: 3 Russian, 1 Western (in Russian translation).

2415/9835  
CSO: 1860/67

UDC 621.396.677.85

#### FEASIBILITY ANALYSIS OF HYBRID LENS ANTENNAS ON BASIS OF GEOMETRICAL OPTICS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 24 Mar 86) pp 76-78

[Article by V.I. Klassen and G.V. Markin]

[Abstract] Considering the advantages of hybrid antennas over phased ones in scanning very narrow ( $10-20^\circ$ ) sectors and very wide (up to  $180^\circ$ ) sectors,



hybrid lens antennas are compared with hybrid mirror antennas and their design is analyzed in the approximation of geometrical optics. While a hybrid lens antenna is characterized by total internal reflection, unlike a hybrid mirror antenna, some incident rays cross the lateral surface of the lens so that some loss of useful energy results. The effect of this loss on the directive gain of such an antenna is evaluated for a focusing lens made of a homogeneous dielectric material in the shape of a lune between two paraboloidal surfaces with a common base circle and an exciter array on or off that circle. Calculations on this basis for scanning and multibeam antennas yield the dependence of the relative geometrical directive gain on the deflection of the radiation pattern and thus on the scanning sector angle at certain ratios of lens height to base diameter, lens riser to base diameter, and base diameter to wavelength. These results provide guidance for the design of such antennas which will maximize the directive gain and the scanning sector within which it remains almost constant. Figures 7; references: 3 Russian.

2415/9835  
CSO: 1860/68

UDC 621.396.677.49

#### STATISTICAL CHARACTERISTICS OF ACTIVE PHASED ANTENNA ARRAYS WITH INTERACTING RADIATORS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 16 Apr 86) pp 79-82

[Article by V.L. Gostyukhin and K.G. Klimachev]

[Abstract] The statistical characteristics of active phased antenna arrays are analyzed and evaluated on the basis of simulation and tests on YeS-1035 computer, using a model based on the matrix theory of antenna arrays and taking into account interaction of radiators. Numerical data have been obtained for a linear waveguide array of 25 equidistant elements with a period of either  $0.6\lambda$  or  $0.3\lambda$ , scanning in the E-plane, with either uniform-amplitude or Chebyshev excitation yielding a side-lobe level of 40 dB. These data reveal different mean-square amplitude and phase deviations in the various radiators, the differences being particularly pronounced between center and end radiators, as well as a dependence of the field fluctuation distribution over the antenna aperture on the interaction of radiators. This indicates a transient nature of random changes of the amplitude-phase distribution in the aperture of an active phased antenna array. Figures 5; tables 2; references: 4 Russian.

2415/9835  
CSO: 1860/68

## APPROXIMATE CALCULATION OF GAIN OF REFLECTOR ANTENNAS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 7 Apr 86) pp 82-84

[Article by N.N. Gorobets, A.F. Lyakhovskiy and V.A. Somov]

[Abstract] An engineering method of approximately calculating the gain of a reflector antennas is outlined, using the definition of gain as the ratio of power density in the major lobe to mean power density produced by a nondirectional antenna with the same excitation power. Algorithms are constructed accordingly for three typical radiator models: 1) amplitude of incident field can be calculated with known excitation power, 2) both gain and radiation pattern of radiator are known or can be determined experimentally, 3) only normalized radiation pattern of radiator is known. These algorithms are simpler than those based on the definition of gain as the product of efficiency and directive gain. They can be extended to two-reflector and other optical antennas.

2415/9835

CSO: 1860/68

UDC (512.86+530.17):583.3

AMBIGUITIES IN INVERSE PROBLEMS OF MACROELECTRODYNAMICS. SPHERICAL AND TOROIDAL SOURCES OF ELECTROMAGNETIC FIELDS (Review)

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 29, No 9, Sep 86 pp 991-1007

[Article by M.A. Miller, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] Following a broad definition of forward and inverse problems, inverse problems being generally characterized by ambiguity, inverse problems of macroelectrodynamics for Maxwell field equations are formulated generally and problems of self-shielding are considered specifically. Their ambiguity having been identified and their solution being predicated on known solution to corresponding forward problems, they are classified with respect to sources of the electromagnetic field: chargeless ones, charge and current sources. Scalar (charge) and vector (current) constant self-shielding sources, interaction of sources, then alternating-current sources are considered for the necessary transition from electrodynamics to electrostatics: one-dimensional (line), two-dimensional (cylinder), three-dimensional (bispherical charge source, toroidal current source,  $\theta$ -bitoroidal current source) statics. Implications of these ambiguities for practical problems involving electromagnetic, Cerenkov, radiation and antenna design theory are discussed, while

some interesting properties of various self-shielding sources are described and irrelevancy of a linear or nonlinear medium is pointed out. The author thanks G.V. Permitin, A.I. Smirnov, and Ye.V. Suvorov for discussions, and S.D. Zhernosek for assistance. Figures 8; references 21: 18 Russian, 3 Western (2 in Russian translation).

2415/9835

CSO: 1860/64

UDC 537.87

#### ROTATING BODIES AND ELECTRODYNAMICS IN ROTATING REFERENCE SYSTEM

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 9, Sep 86 pp 1008-1016

[Article by Ya.B. Zeldovich, L.V. Romanskiy, and A.A. Starobinskiy, Institute of Problems in Physics, USSR Academy of Sciences]

[Abstract] Superreflection of an electromagnetic wave by a rotating body is analyzed by a new method, with the Maxwell field equations formulated in a rotating system of coordinates. They are solved for a cylindrical incident wave, a negative energy term in such a reference system corresponding to amplification by the rotating body. Amplification of an electromagnetic wave generated by a rotating metal cylinder inside a lossless cylindrical reflecting shield within the Fresnel region is considered, with either the electric field or the magnetic field of the wave parallel to the cylinder axis. Spontaneous emission of photon by a rotating cylinder having already been established earlier in a stationary reference system, its intensity is now calculated in a rotating system of coordinates. References 8: 6 Russian, 2 Western (1 in Russian translation).

2415/9835

CSO: 1860/64

UDC 530.18

#### COLLAPSE AND MULTIPLE FRACTIONATION OF NONLINEAR WAVE STRUCTURES

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 9, Sep 86 pp 1137-1144

[Article by N.A. Zharova, A.G. Litvak, T.A. Petrova, A.M. Sergeyev, and A.D. Yunakovskiy, Institute of Applied Physics, USSR Academy of Sciences]

[Abstract] The problem of self-focusing in nonlinear dynamics of three-dimensional waves with a saddle point on the surface of their wave vectors is considered, gravitational waves in deep water and plasma oscillations in a

magnetic field belonging in this class. The behavior of such a wave packet in a nonlinear medium is analyzed on the basis of the corresponding three-dimensional equation  $-iE_t + E_{xx} + E_{yy} + \alpha E_{zz} + |E|^2 E = 0$  with the sign of coefficient  $\alpha$  depending on the dispersion mode and  $\alpha = -1$  in this particular case. With the electric field appropriately explicated, this equation is solved analytically and then numerically for analysis of asymptotic singularity development and of subsequent structural stability of two-dimensional collapsing field distributions. Calculations are made upon transformation from the laboratory system of coordinates to a system of coordinates shrinking to some point. The results demonstrate that multiple fractionation of the spatial field structure is the real cause that limits transverse self-focusing. Figures 4; references 13: 11 Russian, 2 Western.

2415/9835

CSO: 1860/64



## BROADCASTING, CONSUMER ELECTRONICS

### IMPROVING PARAMETERS OF AMPLIFIER DESIGNED AROUND K174UN7 INTEGRATED CIRCUIT

Moscow RADIO in Russian No 9, Sep 86 pp 39-41

[Article by V. Gromov and A. Radomskiy, Lvov]

[Abstract] The K174UN7 IC audio power amplifier would be more widely used if it did not typically have a distortion of up to 10% at an output power of 4.5 W at 1 kHz with a supply voltage of 15 volts, besides having an excessively low input impedance. The primary source of the distortion is "rounding" of the audio waveform on the negative side, or even negative clipping at times. This article details an improved external circuit design employing more negative feedback. Harmonic distortion is reduced to 3% or less at power levels of 1 to 3.75 W between 60 Hz and 10 kHz; the new design works well with an unregulated supply, and a load impedance of 4 ohms. The frequency response is flat within 0.4 dB between 40 and 20,000 Hz. A circuit schematic is provided showing the more sophisticated external circuitry along with graphs of the harmonic distortion as a function of the output power and frequency, supply voltage and also show the maximum power plotted as a function of the supply voltage. Figures 5; references: 2 Russian.

8225/9835

CSO: 1860/46

### LOW FREQUENCY DIGITAL FREQUENCY METER

Moscow RADIO in Russian No 9, Sep 86 pp 49-50

[Article by S. Zasukhin, Leningrad]

[Abstract] Operation and construction details are provided for a homebrew digital frequency meter. The maximum measurable frequency is 100 kHz, the input voltage range is 0.01 to 200 V, the frequency metering count time is 1 s with a display time of 2 s; the input impedance is 300 kohms with an input voltage of less than 5 V and 20 kohms with an input of more than 5 V; the maximum measurable time interval is 99,990 s or 99,990 pulses and the power consumption is no more than 5 W. A 32,768 Hz crystal oscillator

is used along with the following IC's: K176IYe12, K176IYe4, K176IYe3 and K176LA7. The display numerals are IV-3 vacuum luminescent indicators and a simple alignment procedure is also given along with a circuit schematic. Figures 3.

8225/9835

CSO: 1860/46

UDC 681.5.001.63:621.318

**DATABASE FOR EDUCATIONAL COMPUTER-AIDED DESIGN SYSTEM WITH YeS DIGITAL COMPUTER**

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received after revision 11 Nov 85)  
pp 38-42

[Article by L.M. Novozhilova and N.K. Perkov]

[Abstract] The database for a modern computer-aided design system with a YeS digital computer, EMTs-2 upper-level batch processing or EMTs-3 interactive processing, consists of information for determining the codes of models and the values of parameters in specific programs, information for hookup with the user, and information for monitoring the correctness of the description of radioelectronic apparatus to be designed. The programs are now, as a rule, written either in FORTRAN or in PL-1. They are modularized, for classification of apparatus components, for identification and determination of parameters, for parameter conversion, for basic relational algebraic operations of projecting and sampling, also for processing of ratio with adding or dropping of a tuple. The database control occupies approximately 40 kbits in the memory of a YeS-1040 computer with YeS-5061 compiler. Figures 3; references 8: 6 Russian, 2 Western (in Russian translation).

2415/9835

CSO: 1860/74

# SYNCHRONIZATION OF SELF-EXCITED HIGH-FREQUENCY OSCILLATOR ON TWO TRANSISTORS WITH EMITTER-EMITTER COUPLING

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 6 Apr 86) pp 23-25

[Article by S.L. Artemenkov and S.M. Smolskiy]

[Abstract] A differential active element consisting of two transistors with a common emitter circuit is considered as a promising basic structure for production of general-purpose controllable self-excited oscillators by the microcircuit technology, the emitter circuit being formed by a current generator or a resistor. The transient performance of such an oscillator on two identical transistors in a symmetric configuration is analyzed for synchronizability and local stability, an equivalent two-terminal network with a lag element being adequate in the first approximation. Analysis of the steady-state performance yields the synchronization band and the dependence of its width on the circuit parameters as well as on the signal parameters. The oscillator is found to have several advantageous features in addition to a wide synchronization band, namely amplitude limitation and absence of hysteresis effects. Figures 3; references: 7 Russian.

2415/9835

CSO: 1860/68

# NONLINEAR DISTORTION IN NONCAUSAL FILTER ON CHARGE-COUPLED DEVICE

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received 8 Feb 86) pp 26-28

[Article by A.V. Bogoslovskiy and S.I. Miroshnichenko]

[Abstract] Nonlinear distortion of a signal in a charge-coupled device operating as a noncausal filter in the mode of nondirectional charge transfer is evaluated on the basis of a system of two partial differential equations describing both longitudinal voltage and current waves through a nonlinear resistive-capacitive medium. The ripple factors representing harmonics up to and including the fifth only, for low-frequency filtration, have been calculated analytically as functions of the normalized charge transfer time. Including also the sixth harmonic, they have also been calculated by the Runge-Kutta method on a YeS-1022 digital computer. Both results indicate that all these harmonics, but not the fundamental signal component, peak to an integral ripple factor of approximately 0.20 at a normalized charge transfer time within the 0.35-0.4 interval. For an experimental verification of the results, K1200TsM1 microcircuit chips were tested as low-frequency



filters in the mode of nondirectional charge transfer with the normalized charge transfer time of 0.35-0.4 corresponding to an upper cutoff frequency of 200 kHz. Figures 1; references 3: 2 Russian, 1 Western (in Russian translation).

2415/9835  
CSO: 1860/67

UDC 621.396.22.019.4

#### STIPULATING GAINS IN SYNTHESIZED RECEIVERS OF RADIO PULSE SIGNALS

Moscow RADIOTEKNIKA in Russian No 9, Sep 86 (manuscript received after revision 20 Feb 86) pp 28-30

[Article by A.L. Ryabtsov]

[Abstract] Synthesization of radio receivers of radio pulse signals according to the Markov theory of optimal nonlinear filtration is considered, assuming an additive signal and noise mixture with a priori known mathematical expectation of pulse delay time  $T$  as well as noise dispersion  $\sigma_T^2$  and intensity  $N_{TT}$  within a spectrum of given width. Three methods of stipulating  $\delta_T = K_{TT}/\sigma_T^2$  ( $K_{TT}$  - cumulant of Gaussian distribution in synthesized receiver with additive mixture of signal and white noise) are compared, namely without or with averaging over the pulse repetition period (dependent on the pulse time delay) and in the stationary mode with  $d\delta_T/dt \approx 0$  (independent of the pulse time delay). The results of simulation on a digital computer describe the transient process with the filtration error as a function of time in each case, and they indicate that in the steady state this error becomes almost the same no matter how  $\delta_T$  has been stipulated. Figures 2; references: 3 Russian.

2415/9835  
CSO: 1860/67

## OPTOELECTRONIC TRANSVERSAL FILTER ON ARRAY OF CHARGE-COUPLED DEVICES WITH BINARY MASK

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 28 Feb 86) pp 40-43

[Article by I.V. Gryaznykh and I.M. Shelomanov]

[Abstract] An optoelectronic transversal filter is described, such a device consisting of an optical input stage and an  $M \times N$  array of charge-coupled devices forming a delay line and followed by a summing device. The optical signal from a light source such as a light-emitting diode followed by a pulse-amplitude modulator passes through a projecting lens and then through a mask into the CCD array of  $M$  rows and  $N$  columns. The mask is a binary one and the signal leaving the array, a pulse sequence corresponding to the sequence of rows in the array, is split into two by a commutator which sends pulses from the  $1/2M$  upper rows to integrator  $U$  and pulses from the lower  $1/2M$  rows to integrator  $L$  for summation. The output signals from the two integrators are subtracted from one another in a differential amplifier and the difference signal is stored in a memory for sampling after each CCD readout. That readout and switching of the two integrators are coordinated with the memory sampling through a control device. Such a split into two sequences and subsequent subtraction compensates averaged internal noise in the filter, which ensures a wide dynamic range and thus increases the versatility of filter synthesis in terms of different pulse response characteristics. The principle is demonstrated on a  $16 \times 16$  CCD array with binary mask for synthesis of a Humming window. The practical feasibility has been confirmed experimentally with a  $168 \times 64$  CCD array operating in time delay and storage mode at a clock frequency of 500 kHz, using a mask over either upper or lower 84 or the 168 rows and an AL102 light-emitting diode as light source. Figures 2; references 8: 1 Russian, 7 Western (1 in Russian translation).

2415/9835

CSO: 1860/68

## DESIGN OF SELF-EXCITED MICROWAVE OSCILLATORS WITH GaAs FIELD-EFFECT TETRODES

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 12 Mar 86) pp 45-48

[Article by A.V. Khramov]

[Abstract] A procedure for designing self-excited microwave oscillators with GaAs field-effect tetrodes and microstrip lines is shown, such an

oscillator being represented by an equivalent admittance network with a capacitive element in the external positive-feedback loop between drain and second gate. Circuit analysis and design calculations are based on negligible harmonic content in the output signal, power dependence of the output admittance owing to nonlinear characteristics of the second gate, and microwave-voltage dependence of the nonlinear circuit elements within some vicinity of the operating point similar to their bias-voltage dependence. An experimental frequency mixer was designed according to this procedure, with two synchronized oscillators for the 4-6 cm wave band. The deviation of output frequency and output power from their design values did not exceed 10-20% and 25-40% respectively, an accuracy adequate for engineering purposes. Figures 2; references 8: 4 Russian, 4 Western.

2415/9835

CSO: 1860/68

UDC 621.315.22.004.18

## SAVING MATERIALS IN DESIGN AND MANUFACTURE OF BALANCED LONG DISTANCE COMMUNICATIONS CABLES

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 86 (manuscript received 30 Oct 85) pp 54-57

[Article by R.M. Lakernik, candidate of technical sciences and F.F. Nizametdinova, engineer, Moskabel Plant]

[Abstract] Balanced long haul RF communications cables require considerable quantities of aluminum, steel, lead and copper; reducing these costs lowers cable costs. The optimal reduction in product cost without degrading user performance requires a functional cost analysis. This paper analyzes the factors impacting and necessitating changes in cable design (changeover from vacuum tube to lower power solid-state equipment, increased cost of copper, skin effect at higher operating frequencies, difficulty of working with aluminum conductors and the labor intensity of fabricating bimetal and tubular conductor cables) in order to arrive at engineering recommendations for optimal material input requirements. The recommendations call for the use of copper conductors, reducing the diameter from 1.2 to 1.0 mm, the continued use of polystyrene-cord insulation, increasing the output of cables in corrugated steel jackets and reducing the nominal thickness of the polyethylene sheathing from 2.5 to 1.8 mm. These proposals will reduce copper consumption by 30% (50 kg per km of cable) and decrease the material expenditures for the fabrication of the remaining structural components of cables by 7 to 10%. Aluminum jacketed cables developed by the Moskabel Production Association with 1.0 mm cores are being series produced. The conclusions drawn here will enable Moskabel to further expand the production of polystyrene-cord insulated cables in the 12th and 13th Five-Year Plans and increase steel-jacketed cable output from 21 to 35%, saving 600 t of aluminum annually. Insulation and cable parameters are summarized in four tables. References: 5 Russian.

8225/9835

CSO: 1860/75



## POWER DISTRIBUTION FUNCTION AND FREQUENCY-TIME ANALYSIS OF RADIO SIGNALS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received after revision 12 Nov 85) pp 79-82

[Article by A.A. Alekseyev, S.V. Kozhevnikov, and V.A. Aladinskiy]

[Abstract] The complex Rihaczek distribution of energy density in general terms of average or instantaneous active and reactive power is considered for analysis of not only wideband but also narrow-band radio signals in the frequency-time plane. For illustration, the procedure is applied first to a signal leaving an ideal low-pass filter and to one leaving a band-pass filter. The efficiency of this method has been confirmed by experiments on a digital computer involving signals with frequency-keyed or phase-keyed carrier. Figures 2; references 6: 2 Russian, 4 Western.

2415/9835

CSO: 1860/74

## AUTOMATIC CONTROL SYSTEM

Moscow VESTNIK SVYAZI in Russian No 12, Dec 86 pp 23-25

[Article by Yu.B. Osipov, senior engineer, Industrial Laboratory, Kharkov Municipal Relay Center (KhGRTU), A.S. Kiperahetyn, senior engineer, and V.N. Kuritsyn, senior engineer, Station Workshop, KhGRTU]

[Abstract] Workers of the KhGRTU developed a special automatic control system. In comparison with series output, the development of the Kharkov specialists makes it possible to obtain a large volume of information from controlled systems and to reduce the number necessary for telecontrol of trunks. Use of series microcomputers made it possible to automate the technological processes of control and monitoring of the operation of station equipment. The yearly economic effect from introducing the development amounted to 21,000 rubles. At present the efficiency experts of the enterprise are engaged in the development of a system for telemetering the parameters of the distributing feeders, based on the new telecontrol system, a block diagram and a description of which are given. Figures 4.

6415/9835

CSO: 1860/81

## AUTOMATION OF ADJUSTMENT AND SERVICING OF TRANSMISSION SYSTEMS

Moscow VESTNIK SVYAZI in Russian No 12, Dec 86 pp 19-21

[Article by D.R. Bubman, senior scientific research worker, Central Scientific Research Institute of Communications and A.V. Lebedev, chief of laboratory]

[Abstract] In the development of contemporary multichannel transmission systems major attention is given to improvement of methods for adjustment and servicing of equipment. Time-consuming manual operations for measurements and adjustment of equipment are eliminated as concerns unattended repeaters, maintenance operations are centralized and supervision and measurement of channels and equipment are automated by means of computers. This makes it possible to reduce substantially the labor intensity of maintenance and adjustment on lines so as to eliminate approximately 3,000 hand operations on 1,000 kilometers of main lines, reduce the length of maintenance operations, introduce new types of stations: feeder repeaters and totally buried repeaters and increase the labor productivity of maintenance personnel and reduce its quantity (by not less than 30% or 100 persons for 1,000 kilometers of main line). The K-5400 and K-10800 transmission systems are considered. Figures 3.

6415/9835

CSO: 1860/81

## POSSIBILITIES OF NEW TECHNIQUE

Moscow VESTNIK SVYAZI in Russian No 12, Dec 86 pp 16-17

[Article by I.B. Akhmetova, deputy chief, Telegraph-Telephone Station, Ustinov, Udmurtskay ASSR]

[Abstract] In 1986 a report was presented by an Ustinov Telephone-Telegraph Station staff member participating in a Ministry of Communications advanced study group concerning the Telegraf hardware-software equipment for handling nighttime telegraph traffic which replaces manual operations by operators. Introduction of the new technique has increased efficiency for the Ustinov telegraph-telephone station and communication network. Use of the equipment for handling the night load made it possible to reduce the number of telegraph operators by 1.31 staff units and an economic effect totaling 2,437 rubles was obtained. The Ustinov Central Post Office was later able to replace 18 operators' positions by the equipment and to eliminate 15.6 staff units with an economic effect totaling 28,987 rubles. Telegraph operator productivity was increased by 122%.

6415/9835

CSO: 1860/81

## QUASI-OPTIMUM ALGORITHMS OF RADIO SIGNAL RECEPTION AND PROCESSING WITH INCLUSION OF ANOMALOUS TRACKING MODES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 8 Jul 85) pp 1520-1533

[Article by M.A. Mironov and M.S. Yalykov]

[Abstract] Relatively simple quasi-optimum algorithms using polygaussian approximations of a posteriori probability density estimates are constructed for reception and processing of radio signals in accordance with the Markov theory of optimal nonlinear filtration. These algorithms cover not only search and identification of radio signal parameters within the discriminator aperture but also anomalous operating modes such as retuning the tracking channel upon detection of tracking discontinuities. The number of sets of points corresponding to stable equilibrium states  $E_j$  of the optimum discriminator is assumed to be finite or countable, even in the case of vector measurement, the discrimination characteristic satisfying at those points both conditions  $Z(E) = 0$  and  $\partial Z(E)/\partial E > 0$  in the sense of a positive definite or semidefinite corresponding quadratic form. First, however, is considered a scalar process and quasi-optimum algorithms of filtration are constructed so as to also cover tracking anomalies during scalar measurement. The principle is then extended to a vector process and vector measurement, in three steps of discriminator generalization: 1) with finite or countable discrete set of points corresponding to stable equilibrium states along one coordinate only and a single such point characterized by zero mean tracking error along each other coordinate of which the signal is an explicit function, 2) finite or countable discrete set of such points along successively more such coordinates (two, three, ...) and a single such point along each remaining one, 3) continuous set of such points forming a hypersurface in the space of estimation errors of coordinates which the signal is an explicit function of. The algorithms are applied, for illustration to processing of a radio signal

$$s(t, x_1, x_5) = \sum_k \sum_{l=1}^8 A e^{b_l} \text{ where } b_l = \left\{ -\frac{\pi}{2\tau_p^2} (t - t_{kl} - x_1 - x_5)^2 \right\} \cdot \cos[\omega_0(t -$$

$t_{kl} - x_1 - x_5)]$  containing  $k$  packets of  $l$  pulses each with pulse duration  $\tau_p$ ,

pulse repetition period  $T_p$ , packet repetition period  $T_p$ , known amplitude  $A$  and frequency  $\omega_0 = 2\pi f_0$ . The synthesized quasi-optimum processor contains, in addition to a discriminator with selective strobing device and reference oscillator, also three correlation receivers with control device, tunable oscillator, pulse packet shaper, and integral shedder each, as well as a probability computer, a "minimum mean-square error" estimator, a weighting summator, and an extrapolator. The authors thank P.P. Filatov for assistance in computations. Figures 4; references 18: 17 Russian, 1 Western.

2415/9835

CSO: 1860/70

## SET OF INDICATORS CHARACTERIZING UTILIZATION OF RADIO-FREQUENCY SPECTRUM

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 8 Feb 86) pp 3-7

[Article by V.V. Solovyev]

[Abstract] The problem of effective management of the radio-frequency spectrum is considered, a set of two indicators being proposed to characterize the effectiveness of its utilization. They are the specific functional utilization factor referring to an individual radio electronic device and the mean utilization factor referring to a group of such devices. These indicators can serve as a convenient criterion for more effective management of the radio-frequency spectrum. Each of them is defined quantitatively in terms of transmitter and receiver radiation patterns, assuming finite-width uniform amplitude-frequency characteristics, also the load factor and the multiplex factor. An algorithm of random frequency assignment is constructed on the basis of this criterion for solution of the problem of frequency assignment optimization. Figures 1; references 9: 5 Russian, 4 Western.

2415/9835

CSO: 1860/68

## ALGORITHM FOR SELECTION OF OPERATING FREQUENCIES WITHIN CLUSTER OF RADIO COMMUNICATION APPARATUS

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received after revision 3 Dec 85) pp 15-18

[Article by A.D. Kaluzhskiy and Yu.I. Voloshin]

[Abstract] An algorithm is constructed for selection of operating frequencies within a large cluster of radio transmitters and receivers with one common automatic control station. With the aid of a microcomputer are first determined all allowable frequencies, taking into account not a priori known parameters of the ambient electromagnetic field, and then are selected among them those frequencies which match actual signals to be received. As criterion serves the overall electromagnetic compatibility index, weighted sum of apparatus, service, and frequency compatibility indexes. The special model executing this algorithm is included in a model of the radio apparatus cluster, which includes a test signal generator for one transmitter, a set of signal measuring instruments behind each of several receivers with a common data processor, and a service channel. The algorithm has been programmed as an iterative one, the correct final set of operating frequencies being stored in the automatic control station for the cluster. Figures 2; references: 6 Russian.

2415/9835

CSO: 1860/68



## HOW TO EVALUATE THE EFFICIENCY OF OPERATION OF AN AUTOMATIC LONG DISTANCE TELEPHONE EXCHANGE

Moscow VESTNIK SVYAZI in Russian No 11, Nov 86 pp 27-28

[Article by L.I. Shteynbuk, candidate of technical sciences, director, Republic Informational-Computational Center, Ministry of Communications, Latvian SSR, G.A. Leydman, and S.Ye. Timonin, candidate of technical sciences, heads of bureaus, Automatic Control System (Department), Republic Informational-Computational Center]

[Abstract] A system for evaluation of the efficiency of operation of automatic long distance telephone exchanges, with the use of centralized equipment for taking account of cost, assures the output of a large volume of information, making it possible to determine the probability of failures at individual stages of calls. Based on the data obtained it is possible to take measures with respect to reducing the number of failures at one or another stage of calls, leading to an increase of the number of completed calls. At the Riga Telephone-Telegraph Station the probability of failure of an automatic long distance telephone exchange has been established as 0.08 and it has been determined that its reduction by 0.01 will give an increase of receipts of not less than 25,000 rubles in a year. According to the calculations presented, the introduction of a system of automated control of technological equipment into the telegraph-telephone station system makes it possible to reduce the probability of failure by not less than 0.03. The calculated yearly economy amounts to not less than 65,000 rubles with the period of pay-back of capital outlays not more than 1.6 years. The system developed for evaluation of the operating efficiency of an automatic long distance telephone exchange can also be utilized with the employment of other electronic computers and hardware for control during operation of such an exchange. Figures 1.

6415/9835  
CSO: 1860/72

## AUTOMATION WITH THE ASSISTANCE OF A MICROCOMPUTER

Moscow VESTNIK SVYAZI in Russian No 11, Nov 86 pp 29-31

[Article by A.V. Seminyutin, head, Industrial Laboratory, Tallinskiy Telegraph]

[Abstract] Rationalisers of the Tallinskiy Telegraph created several types of peripherals to the DZ-28 microcomputer, with the assistance of which a number of production processes have been automated. As a result, the time for detection of faulty equipment and communications is shortened and telegraph personnel are freed from manual collection and processing of statistical information. The economic effect of the introduction of the microcomputer amounts to 5,000 rubles a year. The following items are

described: 1) The POISK complex of devices which monitor the quality of operation of the telegraph network of the republic in the process of handling an actual load; 2) The complex TARIF which processes information concerning revenues and expenditures of the subscribers of the AT-50, TELEKS, PD-200 networks included in the Tallinskiy Switching Station (operated from November 1983); 3) Complex of devices for automatic determination of the number of a calling subscriber; and 4) Complex for removal and processing of the readings from counters of a Nikola-Tesla telegraph station.

6415/9835

CSO: 1860/72

#### PSV-0.1 LOW-POWER MEDIUM-WAVE TRANSMITTER

Moscow VESTNIK SVYAZI in Russian No 11, Nov 86 pp 31-32

[Article by M.S. Landsman, head, Zonal Laboratory, Republic Unit For Broadcasting, Radio Communication and Television (Kiev)]

[Abstract] The PSV-0.1 low-power medium-wave transmitter is intended for broadcasting towards little populated points in the zone of uncertain reception of high-power radio broadcasting and where reception of the signal of such stations is impossible because of the contours of the locality (e.g., in mountainous regions) or for other reasons. This transmitter was developed and manufactured by the zonal laboratory, Republic Unit for Radio and Television of the UkSSR Ministry of Communications. It's use made it possible to obtain an economical effect of about 42,000 rubles because it reduces the need for standard radio station service. The PSV-0.1 is described and a block diagram and a photograph of it are presented. Figures 3.

6415/9835

CSO: 1860/72

UDC 678.026:621.315.616.97

SEMI-AUTOMATIC MACHINE FOR POTTING HIGH VOLTAGE PRODUCTS IN EPOXY COMPOUND

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 86 p 63

[Article by E.O. Sork, M.V. Yarv, E.P. Pilpak, M.F. Viysimaa, and T.Kh. Haggi, engineers, Scientific Research Institute, Tallin Electrical Equipment Plant imeni M.I. Kalinin Production Association]

[Abstract] The MZVE-9 semiautomatic potting machine was constructed for hermetically sealing the components of high power semiconductor converters by potting them in an epoxy compound based on the ED-8 resin with a filler of powdered quartz and a hardener. The electrical test voltage of the sealed windings is 50 kV and the maximum amount of compound is 80 kg per potted assembly. The system includes closed heated tanks with mechanical mixers, plunger type apportioning mechanisms with a mechanical, controlled drive, a flow-through mixer with a pneumatic valve and a heated vacuum chamber. The maximum size of the potting forms is 600 x 600 x 800 mm. The maximum power consumption is 25 kW and the output with a potting volume of 2,000 cm<sup>3</sup> is 20 to 40 products per hour. The prototype VZVE-9 was placed in service at the Tallin Electrical Equipment Plant and the calculated annual economic savings is 30,000 rubles.

8225/9835

CSO: 1860/75

UDC 681.325.3

ITERATIVE CODE FOR CORRECTING ERROR IN BIT DATA ARRAYS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 11, Nov 86 (manuscript received 7 Jun 84) pp 50-53

[Article by V.I. Potarov, O.P. Shafeyeva, and I.A. Palyanov, Omsk  
Polytechnical Institute]

[Abstract] One of the most promising directions in developing a means for increasing the reliability of binary data transmission is the use of codes for detection and correction of errors. In data arrays correction of errors is most commonly performed by encoding of information by iterative codes. The present article proposes a method for constructing a code with a check of the parities of the column and diagonal bits for blocks of bit data words, which provides a modification of a known code with a check on the parity with respect to lines and diagonals for correction of errors on a magnetic tape. Figures 2; references: 2 Russian.

6415/9835  
CSO: 1860/82

ASPECTS OF USE OF MICROPROCESSORS AND MICROCOMPUTERS

Moscow VESTNIK SVYAZI in Russian No 12, Dec 86 pp 21-23

[Article by A.I. Kushtuyev, V.S. Bondarenko, and K.V. Konoplev, staff  
members, Scientific Research Institute for Radio Components]

[Abstract] The idea of creating universal integrated circuits, the function of which would not be prescribed by a circuit diagram of its elements (by rigid logic), but by a programmed route found its realization in microprocessors and microcomputers with flexible architecture, making it possible to realize a wide range of operations. The development of microprocessors proceeds vigorously: four generations succeeded each other in eight years. Developments in the field are reviewed in relation to the third and fourth international symposiums on microprocessors and microcomputers which took



place in 1983 and 1985 at Budapest, in the work of which approximately 500 specialists from 20 countries took part.

6415/9835

CSO: 1860/81

#### RADIO-86RK RADIO AMATEUR PERSONAL COMPUTER

Moscow RADIO in Russian No 9, Sep 86 pp 27-28

[Article by D. Gorshkov, G. Zelenko, Yu. Ozerov, and S. Popov, Moscow]

[Abstract] This article concludes the description of the small Radio-86RK PC intended primarily for instructional and amateur purposes (RADIO, 1986, Nos. 4-8). The main memory RAM has a 16 Kbyte capacity, though this can be increased to 32 Kbyte, which naturally necessitates changes in the software. This article discusses the distribution of the main memory for MONITOR operation, certain features of keyboard operation as well as the display control codes. The most complex of the latter is the function for direct cursor addressing: in order to set the cursor to a required position on the display, a sequence of 6 codes must be displayed, which is because of the requirement of compatibility between these PC codes and the sets of display codes of commercially manufactured PC's. Tables 2.

8225/9835

CSO: 1860/46

UDC 621.382:537.222.22

**ELECTROSTATIC FIELDS IN SPACE-CHARGE-WAVE DEVICES FOR PROCESSING MICROWAVE SIGNALS**

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 10 Nov 83, after correction 22 Feb 85) pp 1635-1644

[Article by M.A. Kitayev, A.L. Kogan, and Ye.I. Ryzhova]

[Abstract] The distribution of an electrostatic field in a long thin semiconductor film on a much longer thick dielectric substrate is analyzed, such a structure made of a two-valley semiconductor material with electron drift and negative differential conductance in a state of charge non-equilibrium serving as a space-charge-wave device such as a microwave converter. Theoretical calculations are supplemented with experimental data on GaAs specimens. A uniform profile of an electrostatic field of above-threshold intensity is found to be attainable over most of the length of a semiconductor structure much longer than the space-charge wave and with a depletion region near the ohmic source electrode or an enhancement region near the source electrode with limited injection, by use of a Schottky barrier. The authors thank G.L. Gurevich for interest and helpful discussions. Figures 4; references 13: 6 Russian, 7 Western (1 in Russian translation).

2415/9835  
CSO: 1860/70

## SATURATION VOLTAGE AND CURRENT GAIN OF HIGH-VOLUME DARLINGTON TRANSISTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 15 Jun 83, after correction 15 Apr 85) pp 1645-1650

[Article by B.I. Grigoryev and V.V. Togatov]

[Abstract] The characteristics of high-voltage transistors in a Darlington pair are calculated on the basis of Kirchhoff's laws for the equivalent circuit and both  $n^+ - n - p - p^+$  four-layer structures, with either the collector-emitter voltage  $V_{CE}$  or the base current  $I_{b1}^+$  of the input transistor given. The corresponding equations are solved for the two collector currents  $I_{C1}$ ,  $I_{C2}$ , the base current  $I_{b2}$  of the output transistor, and the thicknesses of the modulation layers. The results are used for determining the output voltage-current characteristic  $V_{CE} = f(I_C)$  indicating the saturation voltage and then the current gain  $\beta$  as a function of the output current  $I_C$  or of the output voltage  $V_{CE}$ , with both transistors driven to saturation in the most general case. These theoretical relations agree fairly closely with experimental data on a Darlington pair of KT704 transistors. Figures 6; references 6: 5 Russian, 1 Western.

2415/9835  
CSO: 1860/70

UDC 62-504.3(075.8)

INVESTIGATION OF ONE CLASS OF DIGITAL SERVO SYSTEMS AS VARIABLE LAG SYSTEMS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 11, Nov 86 (manuscript received 3 Mar 86) pp 22-27

[Article by S.N. Suvorov, Moscow Aviation Institute imeni S. Ordzhonikidze]

[Abstract] Algorithms are developed for investigation of dynamic processes in digital servo systems (DSS) of a specific class, by means of a representation of them in the form of analog systems with variable lag. An example of a DSS of the third order is considered. Practical recommendations are given with respect to a choice of the numerical values of the parameters of the system under consideration. The investigations conducted show that DSS in continuous form which have a variable lag make it possible to conduct both a qualitative analysis and a parametric synthesis of a similar class of systems with any order of the equations. As a function of the order of the DDS, only a number of terms in certain formulas of the article are changed. This indicates the universality of the algorithms obtained and the effectiveness of their use in practice. Figures 4; references: 6 Russian.

6415/9835  
CSO: 1860/82

UDC 681.325.3

REDUCTION OF THE SENSITIVITY OF A SHAFT-CODE PHOTOELECTRIC TRANSDUCER TO THE ACTION OF DESTABILIZING FACTORS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 11, Nov 86 (manuscript received 26 Feb 86) pp 46-50

[Article by B.Ye. Morshchikhin, Leningrad Mechanical Institute]

[Abstract] Problems are considered with respect to the construction of shaft-code photoelectric transducers with low-sensitivity to the action of a wide spectrum of destabilizing factors. A means for reducing the



instrumental errors of the transducer is proposed. A block diagram is presented of a parametric source of stabilized current for the light-emitting diodes which prolongs the operational period of the transducers under various conditions. Figures 3; references: 6 Russian.

6415/9835  
CSO: 1860/82

UDC 681.518.22

# ASYMPTOTIC IDENTIFIERS OF STATE VECTOR OF NONSTATIONARY DYNAMIC OBJECTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 10, Oct 86 (manuscript received 24 Jun 85) pp 16-21

[Article by Yu.S. Manuylov, V.V. Chernysh, V.V. Taran, and S.V. Smirnov, Leningrad]

[Abstract] An asymptotic identifier of the state vector is synthesized for control of linear nonstationary dynamic objects on the basis of the observability criterion. Both object and identifier are described by a system of two equations which includes an  $n$ -dimensional state vector  $X(t)$  an  $n \times n$ -dimensional object matrix  $A(t)$ , an  $n \times m$ -dimensional control matrix  $B(t)$ , an  $r \times n$ -dimensional transducer matrix  $C(t)$ , an  $r$ -dimensional vector  $Y(t)$  of transducer output parameters, and an  $m$ -dimensional vector  $u(t)$  of control parameters ( $t$ - time). The problem is to find an  $n \times (p+r)$ -dimensional matrix  $W(t)$  such that  $\lim_{t \rightarrow \infty} X(t) - W(t) \begin{bmatrix} Y(t) \\ Z(t) \end{bmatrix} = 0_n$  ( $0_n$ -  $n$ -dimensional null

vector). The  $p$ -dimensional identifier vector  $Z(t)$  is related to the state vector  $X(t)$  through the equation  $Z(t) = T(t)X(t) - e(t)$  containing a  $p \times n$ -dimensional matrix function  $T(t)$  and a  $p$ -dimensional vector  $e(t)$  of identification errors. The system of equations reduces to one of  $(n^2+np)$ -th order with  $n^2+np+p^2+pr$  unknowns,  $p^2+pr$  of which must be predetermined so as to ensure the existence of a unique nontrivial solution and negative real parts of eigenvalues. References 3: 1 Russian, 2 Western.

2415/9835  
CSO: 1860/63

## SYNTHESIS AND USE OF SUBOPTIMUM TEST SIGNAL FOR IDENTIFICATION OF NONLINEAR DYNAMIC OBJECTS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 10, Oct 86 (manuscript received 16 Jul 85) pp 28-33

[Article by V.F. Yakovlev, Kuybyshev Polytechnic Institute imeni V.V. Kuybyshev]

[Abstract] Algorithms for identification of nonlinear dynamic objects definable by discrete Volterra series are proposed, using plans on the basis of M-sequences with a suboptimum test signal. The number of parameters in the Volterra model and the amplitude of the test signal along with the discretization step are selected on the basis of a priori information, whereupon the characteristic polynomial is selected for the M-sequence with optimum correlation properties so that the largest number of ordinates identifying the Volterra kernels can be determined with minimum M-sequence length. These algorithms are much more efficient than conventional ones such as the Plackett-Berman plans, especially when the fast Walsh transformation or the Weitz algorithm can be included. They are easily implemented on microcomputers, typically for identification of electric arc and control of plasmochemical equipment. Figures 4; tables 1; references 8: 3 Russian, 5 Western.

2415/9835  
CSO: 1860/63

## TECHNICAL IMAGE PROCESSING SYSTEMS: STATE OF ART, PROBLEMS, AND OUTLOOK

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 10, Oct 86 (manuscript received 13 Nov 85) pp 75-85

[Article by M.A. Velikotnyy, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] Technical image processing for object recognition by robots in flexible automatic production systems is reviewed following a general comprehensive sequence. It begins with the optical information space in the target medium, continues with optical or optoelectronic projection, generation of adequate electrically simulating video signals subsequently converted into a form convenient for further processing, extraction of information carrying parameters according to problem solution logic, interpretation of the image on the basis of data sampling and decision rules, then ends with recording and control which includes feedback to the optical information space. Each stage is discussed, problems and their solution are analyzed with reference to relevant studies and reports, whereupon applications and

necessary performance requirements are identified. Applications include inspection for quality control, tracking the position and the motion of objects in an industrial plant or for navigation purposes, and special applications such as spectroscopy of fast processes. Past achievements and further development trends are indicated, without delving into still debatable aspects but with emphasis on the role of technical image processing in eventual integration of industrial systems. Figures 2; references 60: 31 Russian, 29 Western (9 in Russian translation).

2415/9835

CSO: 1860/63

UDC 538.563

UTILIZATION OF NONLINEAR ADAPTIVE COMPENSATOR FOR DISCRIMINATION OF TEMPERATURE PULSATION SOURCES IN HEAT EXCHANGER CHANNEL

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received 3 Jan 85, after revision 23 Aug 85)  
pp 927-933

[Article by Yu.S. Konev, A.A. Maltsev, V.I. Merkulov, and F.A. Numoin,  
Gorkiy State University]

[Abstract] While linear adaptive compensators are widely used to suppress and discriminate interference sources in a variety of instrumentation applications, the signal conversion in some systems is quite nonlinear and a nonlinear adaptive compensator that automatically approximates the first few terms of a Volterra series must be used to combat the interference. This paper analyses the application of such an adaptive compensator to the discrimination of temperature pulsations in the walls of a double-pipe, counterflow heat exchanger. The compensator is a nonlinear adaptive filter designed around a delay line with nine weighting coefficients simulated by a computer. The feasibility of this technique is demonstrated on a test stand using a stainless steel double tube exchanger instrumented with thermocouples. The temperature pulsations in the wall of the heat exchanger channel were measured for average rates of flow of the heating water of  $2,700 \text{ kg/m}^2 \cdot \text{s}$  and  $260 \text{ kg/m}^2 \cdot \text{s}$  with an average coolant mass rate of flow of  $25 \text{ kg/m}^2 \cdot \text{s}$ . The relative fluctuations in the coolant rate of flow for various heating water flow rates are plotted at frequencies from 0 to 2 Hz. The nonlinear adaptive compensator discriminates temperature pulsations due to longitudinal oscillations in the average cooling water velocity over the cross-section as well as flow turbulence. The method can also be used to estimate the parameters of a simplified nonlinear heat exchange model in a steam generator. Figures 5; references 11: 9 Russian, 2 Western (in Russian translation).

8225/9835  
CSO: 1860/42

# INFLUENCE OF STATE OF LUBRICATION FILM ON LOAD-CARRYING CAPACITY OF GAS DYNAMICS THRUST BEARINGS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 11, Nov 86 (manuscript received 14 Mar 86) pp 58-62

[Article by B.A. Aryefyev, Ch. Reginya, and N.B. Talaykova, Leningrad  
Institute of Precision Mechanics and Optics]

[Abstract] It is shown that a drop in the load-carrying capacity of a gas dynamics thrust bearing, which begins at a definite frequency of rotation (of the compressibility number) and a further decrease of this basic index of the equipment, is connected with disturbance of the steadiness of the lubrication flow. Figures 2; references: 6 Russian.

6415/9835  
CSO: 1860/82

# ELECTRICAL CONDUCTIVITY OF LIQUID METALS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA  
in Russian Vol 27, No 5, Sep-Oct 86 (manuscript received 5 Jul 85) pp 35-40

[Article by L.P. Filippov, Department of Molecular Physics, Moscow University]

[Abstract] Available experimental data on the electrical conductivity of liquid alkali metals (Cs, Rb, K, Na, Li) are fitted into the Drude theory and correlated with electrical conductivity of these metals in the solid state. From the basic relations for the ratio of mean free path for electrons to mean distance between ions and by extrapolation of the temperature dependence of the orthobaric density are obtained the pressure dependence of the electrical conductivity as well as its relation to thermophysical and acoustical properties of these metals. Figures 3; tables 3; references 8: 5 Russian, 2 Western.

2415/9835  
CSO: 1860/69



## STABILIZATION OF CAPACITIVE TRANSDUCERS FOR BULK MATERIALS

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 10, Oct 86 (manuscript received 16 Apr 86) pp 66-70

[Article by S.S. Galushkin and Ye.S. Krichevskiy, Leningrad Institute of Mining imeni G.V. Plekhanov]

[Abstract] The design of high-frequency capacitive transducers for testing bulk materials in laboratory and in industry is analyzed for optimization of performance under conditions of wear. A coaxial pair of identical ring electrodes is considered, each made of the same low-wear material and each with a bevel on the outside making frequent recalibration unnecessary. Capacitance calculations for such a transducer are simplified by developing the ring electrodes into a plane as straight coplanar strips of length  $2-R$  each,  $R$  being the inside radius of the rings. Wear tends to increase this radius and thus the length of the strip electrodes while decreasing their width. The optimum bevel angle, a function of the electrode width and thickness (difference between outside and inside radii) as well as of the distance between electrodes, will ensure minimum measurement error and maximum stability of readings. Expressions are derived for the capacitance of such a transducer and for the error due to linearization, depending on the electrode thickness and on the distance between electrodes. Figures 3; tables 2; references: 6 Russian.

2415/9835  
CSO: 1860/63

UDC 621.397.7:681.3:531.71

## COMPUTER-AIDED TELEVISION SYSTEM FOR CHECKING LINEAR DIMENSIONS OF PARTS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 13-15

[Article by M.T. Krayushkin and A.V. Uvarov]

[Abstract] Contactless measurement of product parameters in machine building and instrument making is accomplished with a TV imaging system using a standard Elektronika VL100 television and an Elektronika 60 microcomputer. The operation of this TSVK-01 measurement system is based on the optical discrimination of the information fragments of the shadow projection of the parts under test, the conversion of the optical information by a video signal driver array and the subsequent conversion of the video signal to a binary code, which is processed in the microcomputer. The optical transducers are CCD's, since they provide excellent raster geometry precision, a wide spectral range and high sensitivity for the optical array. Each CCD matrix functioning as a video signal generator contains a photo-sensitive storage section consisting of 33,408 image elements in a  $21 \times 21$

micrometer array and a 235-element output register for the output of a digitally encoded video signal. The physical configuration of the apparatus is shown along with a block diagram of the control computer. Extensive measurements show that the systematic component of the measurement error has an absolute value of no more than 4.5 to 5 micrometers after 8 h of continuous operation; the random error is no more than 14 micrometers. These specifications conform to the requirements of GOST 8.051-73 for a wide range of product dimensions with tolerances in precision class 7 and better. The system can measure linear dimensions up to 65 mm long in mass production operations. Figures 2; references 6: 5 Russian, 1 Western.

8225/9835

CSO: 1860/44

UDC 535.14

#### GRADIENT CALORIMETER FOR MEASURING ENERGY PARAMETERS OF OPTICAL RADIATION

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 23-24

[Article by V.N. Timoshenko, N.G. Kokodiy, V.F. Yefimov and V.Ya. Krisyuk]

[Abstract] Existing variable temperature calorimeters used for high level optical power measurements have considerable size and weight (up to 15 kg with lengths of 600 mm), necessitating measurement times of up to 30 minutes. Much faster response can be obtained with a calorimeter in which the optical radiation impinges on a plate that measures the temperature difference between its front and back surfaces, i.e. the temperature gradient. The absorbing structure in this calorimeter has the form of a stack of knife-like blades, made with nickel-plated copper plates 5 mm thick. This paper adduces an equation for the thermal response time of such a gradient calorimeter and provides confirming experimental data from a device with a detecting area of copper with dimensions of 100 x 100 x 30 mm for energy levels up to 1,000 J. The heat distribution takes about 6 s, with the maximum temperature attained in 0.04 s, and then falling to 3% of the maximum in 6 s. With an energy input of 1,000 J, the overall heating temperature is low (0.58°C), making it possible to quickly repeat a measurement. The device weighs about 6 kg, uses a digital voltmeter for the data readout and has a sensitivity of 10 microvolt · J<sup>-1</sup>. The total measurement error is no more than 10%. The upper power level measurement limit is due to the destruction temperature of the glue used to attach the bolometers and is equivalent to a power of no more than 50 W. Figures 2; references 3: 2 Russ'an, 1 Western.

8225/9835

CSO: 1860/44

## THRESHOLD OPTICAL SIGNAL PROCESSING IN SCANNING ANGLE-TO-CODE CONVERTERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 24-25

[Article by K.I. Bogatyrenko]

[Abstract] A laser beam can function as a "long pointer" in a scanning angle to code converter. However, in the known designs, the transverse beam section cannot be disregarded in precise measurements when the spacing between the source and the photodetector can change. This paper describes a converter configuration that eliminates the error due to the finite size of the beam. The error correction technique is based on the use of a threshold detector with a tracking threshold for resolving the output signal from the photodetector receiving the laser beam that is bounced off of a rotating mirror. A block diagram of the system is supplemented with analytical expressions defining the measurement error of the converter. The technique was demonstrated in a dual coordinate analog to digital motion transducer for encoding graphics images with a scanning laser beam. The photodetector was a FEU-68, with a semitransparent diffusing screen in front of it. The detector output pulse had a well-defined flat top and its amplitude was independent of the distance of the beam from the detector or the angle of incidence. The maximum absolute angular error was 8 sec. Figures 2; references: 7 Russian.

8225/9835

CSO: 1860/44

## PROCEDURE FOR DETERMINING CALIBRATION PARAMETERS OF PHOTOMETERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 26-27

[Article by V.V. Kudryavtsev, A.V. Smirnov and M.V. Chadeyeva]

[Abstract] While direct methods are still the most often used in the calibration of photometers (using standard attenuators to produce a specified change in the input flux), the certification of the requisite attenuators is especially difficult for large flux densities. It is possible to calibrate photometers by means of uncertified attenuators, given two assumptions: 1) The calibration characteristic is considered to be defined apriori by a converging functional series (e.g. a power series); 2) The test operations performed on the optical radiation are either multiplicative or additive. This paper mathematically describes an optical flux density measurement technique based on the above assumptions that uses glass attenuators with an unknown density when performing a series of multiplicative tests. Still, at least one calibrated attenuator is required that has a known transmittance. A numerical experiment in which the function  $u = \log(1 + 100 t)$  was used to define the calibration curve

demonstrated that with a calibrated attenuator transmittance of  $t_0 = 0.5$ , the execution of 5 multiplicative tests made it possible to achieve an approximation precision of no worse than 0.2% in a dynamic range of 2 orders of magnitude. The experiment also showed that in order to determine the calibration characteristic within 0.1% the calibrated attenuator must have a transmittance precision within 0.05% and have an instrument error of about 0.01%. This technique is recommended for extensive use in calibrating industrial photometers. Figures 1; references 5: 4 Russian, 1 Western (in Russian translation).

8225/9835  
CSO: 1860/44

UDC 621.317.78.089.6:389.14:006.354.065

#### ELIMINATING MISMATCH ERROR WHEN CALIBRATING MICROWAVE WATTMETERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 50-52

[Article by Sh.Kh. Iskharov, A.V. Mylnikov and V.G. Chuyko]

[Abstract] The potential precision of the calibration of working microwave wattmeters is constrained by the errors arising when transferring a standard power unit from a national reference standard. Such errors include the mismatch error, which can predominate in a number of cases (running up to 2%). This paper proposes a method for eliminating this error based on the insertion of a section of waveguide equivalent to a lossless quarter-wave section in the measurement channel. The length of the transmission line section is such that with slight changes in the signal frequency, the electrical length of the section changes by exactly a quarter wavelength, thereby maintaining a response equivalent to the insertion of the quarter-wave section. Analytical expressions are derived for the requisite calibration factors as a function of the frequency difference with and without the section inserted for the case of an in-line microwave wattmeter. The proposed mismatch error elimination method was demonstrated in a comprehensive automated test facility for calibrating low level waveguide wattmeters. The system included a programmable test frequency generator, M1-10 and M1-11 power level calibration meters, and an MT-3 thermistor bridge with a V7-23 digital voltmeter. A block diagram of the automated test system is provided along with a discussion of the control algorithm. At frequencies of 18.0 and 21.0 GHz, the method reduces the dominant component of the mismatch error by a factor of 10. The method is best for the shortwave portion of the centimeter and the millimeter bands. Figures 1; tables 1; references: 6 Russian.

8225/9835  
CSO: 1860/44



UDC 537.624.001.24

## ENERGY FLUX IN BACKWARD BULK MAGNETOSTATIC WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 6 Feb 85) pp 1487-1494

[Article by K.V. Grechushkin, A.V. Stalmakhov and V.A. Tyulyukin]

[Abstract] The energy flow in the lowest two modes of a bulk magnetostatic wave propagating through a tangentially magnetized ferrite film is analyzed, letting the angle between the wave vector and the direction of the constant magnetic field vary arbitrarily from critical corresponding to cutoff of a surface magnetostatic wave to zero corresponding to a backward bulk magnetostatic wave. Theoretical calculations are made for a thin but semiinfinitely wide and long ferrite film in a constant magnetic field parallel to one of its two orthogonal edges. A backward bulk magnetostatic wave is generally a multimode wave, each mode having its particular dispersion law and carrying a high-frequency magnetic field with a particular number of variations within the thickness of the film. The rate of energy transfer through various characteristic structural regions of the film is calculated in the approximation of magnetostatics, with not only the angle of the wave vector but also the frequency of the excitation signal varied so as to establish its dependence on both. The results are correlated with experimental data on volume magnetostatic waves excited by a microwave oscillator through a microstrip-line converter with 3 mm aperture in an 18  $\mu$ m thick  $Y_2Fe_3(SO_4)_3$  (yttrium-iron garnet) semidisk 60 mm in diameter, sufficiently large to render edge effects negligible. Figures 5; references 9: 4 Russian, 5 Western (one in Russian translation).

2415/9835

CSO: 1860/70



## TRANSFER FUNCTION OF MAGNETOSTATIC-WAVE MICROWAVE DEVICES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 30 Jul 84) pp 1627-1634

[Article by V.A. Lysenko]

[Abstract] The transfer function of magnetostatic-wave microwave devices is calculated on the basis of a model of such a device consisting of an input converter and an output converter with a bilaterally metallized dielectric-ferrite-dielectric transmission line between them. The transfer function includes an equivalent input impedance followed by conversion losses and transmission losses, radiation losses also taken into account. Waves are assumed to propagate from the input converter in two opposite directions, with wave numbers  $k_n^+$  and  $k_n^-$  respectively ( $n$ - mode order). Calculations are based on the duality theorem and are made in the linear approximation, assuming a negligibly anisotropic ferrite film. They involve 14 expressions relating pertinent circuit parameters to pertinent geometrical dimensions of the structure, with given dielectric permittivity and magnetic permeability of the active materials. The design of surface-magnetostatic-wave devices with converters made of copper is analyzed. The frequency characteristics of the components of their transfer function over the 9-10 GHz range have been calculated theoretically on the basis of numerical design data and experiments with  $Y_3Fe_2(SiO_4)_3$  (garnet) as waveguide material have yielded promising results. Figures 4; references 14: 8 Russian, 6 Western.

2415/9835

CSO: 1860/70

UDC 621.396.67.001.24:778.38

OPTIMUM SOLUTIONS AND QUASI-SOLUTIONS TO PROBLEMS OF MICROWAVE HOLOGRAPHY

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received after revision 3 Jul 85) pp 1495-1506

[Article by Ye.N. Voronin]

[Abstract] Microwave holography is considered, namely recording a microwave field with the aid of multipositional coherent receivers on a hologram and subsequently reconstructing the space-time distribution of active and passive sources constituting the scene. Algorithms are constructed for solving the reconstruction problem optimally with respect to the r.m.s. criterion or with respect to the error functional, in a form applicable to all possible recording modes. Both criteria are in this case very narrow and not necessarily adequate from a practical standpoint such as stability, however, so that a suboptimum solution, quasi-solution or pseudosolution, satisfying an additional constraint such as one on the norm is needed for easy analog-digital processing and prevention of error buildup. Such a quasi-solution is obtained by the variational method, which reduces the problem to minimization of the regularizing functional. In order for this functional to be adequately stabilizing, it is necessary that there be correlation between a specific error and the corresponding processor figure-of-merit with respect to possible variations of the sought space-time signal vector. An algorithm is then constructed accordingly which applies to all possible modes of deterministic and statistical regularization for obtaining pseudosolutions to the general fundamental algebraic operator equation of hologram reconstruction. Figures 3; references 28: 24 Russian, 4 Western (1 in Russian translation).

2415/9835  
CSO: 1860/70

## MATHEMATICAL MODELING OF GaAs REFLECTOR WAVEGUIDES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 11 Sep 84) pp 1516-1519

[Article by G.S. Makeyeva and O.A. Golovanov]

[Abstract] A mathematical model has been constructed to describe a GaAs microwave reflector waveguide. The physical model of such a waveguide is a structure consisting of an n-GaAs film deposited on a semiinsulating rectangular GaAs substrate bar and metallized along its both lateral edges, all inside a shielding waveguide. The mathematical model is based on an analysis of the waveguide electrodynamics, which has yielded the dependence of the relative propagation constant and attenuation coefficient for odd and even modes on the thickness and the electrical conductivity of the n-GaAs film and well as on its distance from the shield, also taking into account formation of a static strong-field domain with negative differential conductance in the film. Modeling by the method of independent multimode structural components can be done on a YeS-1052 computer. It has been covering the 35-60 GHz frequency range and n-GaAs films up to 50  $\mu\text{m}$  thick with the electrical conductivity varied over the 0.1-10 S/cm range. Figures 5; references 7: 6 Russian, 1 Western.

2415/9835

CSO: 1860/70

## DIPOLE APPROXIMATION IN THEORY OF DIFFRACTION BY EDGES OF SMALL HOLES NEAR PARALLEL SHIELDS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 31, No 8, Aug 86  
(manuscript received 26 Jun 85) pp 1651-1653

[Article by Kh.L. Garb, R.S. Meyerova, G.V. Pochikayev, and P.Sh. Fridberg]

[Abstract] Diffraction in microwave devices such as microstrip-line waveguides with reduced height for circuit integration is considered and, for an analysis of this problem, the Rayleigh-Mandelshtam-Bethe dipole approximation is shown to remain valid in the case of diffraction by edges of small holes near parallel shields. Its validity is demonstrated on an electromagnetic wave passing through a hole in an infinitesimally thin wall between two media. The polarizability is in this case determined from the solution to the leakage problem for a uniform electrostatic field with Dirichlet boundary conditions at the entire wall surface. The results indicate that adequate physical models will yield a close agreement with experimental data. Figures 4; references 5: 4 Russian, 1 Western.

2415/9835

CSO: 1860/70

## MEASUREMENT OF PARAMETERS OF MICROWAVE PULSE DISCHARGE IN WAVEGUIDE BY CONDUCTANCE METHOD

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA  
in Russian Vol 27, No 5, Sep-Oct 86 (manuscript received 16 Jul 85) pp 15-21

[Article by P.S. Bulkin, G.S. Sontsev, S.A. Dvinin, and I.E. Shkradyuk,  
Department of Electronics, Moscow University]

[Abstract] A method of diagnosing a microwave pulse discharge inside a waveguide under atmospheric or nearly atmospheric pressure on the basis of plasma conductance measurements is outlined, discharge pulses of 3  $\mu$ s duration with a repetition rate of 400 Hz having been excited and sustained experimentally inside a rectangular waveguide with 72x34 mm<sup>2</sup> cross-section by means of a 3 GHz decimetric wave. Known expressions for both reflection and transmission coefficients in such a waveguide and for the conductance of a plasma channel are used for calculating the ratios of electron concentration to frequency of electron-atom collisions under microwave excitation and under d.c. excitation respectively, these relations being valid when the collision frequency is much higher than the field frequency without field redistribution within the plasma volume and the plasma thickness (diameter) is smaller than the skin depth. Measurements were made under simultaneous but separate microwave and low-voltage (1-10 V) d.c. excitation. One electrode, at ground potential, was touching the waveguide wall through a hole in which it was inserted. The other electrode, inserted through a hole in the opposite wall, cleared the wall mechanically but was coupled to it electrically through a capacitor - a bushing formed by two coaxial cylindrical plates with the inner plate wrapped around the electrode, the outer plate mounted on the waveguide wall, and polystyrene filling the space between them. With this equipment have been determined the dependence of the plasma channel length and diameter as well as of the ratio of electron concentration to collision frequency on the input power and on the length of the interelectrode gap inside the waveguide. Figures 5; references 3: 2 Russian, 1 Western.

2415/9835

CSO: 1860/69

UDC 621.315.3:621.315.617:621.313.13:621.65.03

**WINDING CONDUCTORS WITH FILM INSULATION FOR SUBMERSIBLE OIL PRODUCTION  
ELECTRIC PUMP MOTORS**

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 86 (manuscript received 3 Jul 85)  
pp 52-54

[Article by A.A. Gnedin, engineer and G.I. Meshchanov, candidate of technical sciences, All-Union Scientific Research, Planning, Design and Process Engineering Institute for the Cable Industry]

[Abstract] Increasing the power and efficiency of oil-filled submersible electric motors used in the oil production industry is best accomplished by decreasing winding insulation required, since borehole size now constrains other increases in motor dimensions. The U.S. companies of Byron Jackson Pump Division and Reota Pumps successfully used fluoroplastic polyimide films (such as Kapton F) produced by DuPont in such applications. The USSR has now developed and introduced a similar insulation, type PMF-S, widely used in the electrical cable industry. This film comes with either a single sided or double-sided fluoroplastic coating. This paper details the proof of performance testing of such motor winding insulation, noting the decrease in the relative elongation of PMF-S-352 film after 4,800 h of service during ageing in transformer oil at temperatures between 20 and 180°C. Breakdown voltage and mechanical strength specifications for PPI-U conductors with PMF-S insulation, showing performance comparable to Kapton F. The cable industry has placed PPI-U winding conductors 2.00 to 3.15 mm in diameter in production for severe duty requirements in submersible motors. These conductors have made it possible to design and mass produce new three-phase asynchronous motors for ambient temperatures up to 90°C. Figures 4; tables 2; references 5: 2 Russian, 3 Western (1 in Russian translation).

8225/9835  
CSO: 1860/75



**APPLICATION OF MICROCOMPUTER TO ANALYSIS OF TECHNICAL CONDITION OF PLASTIC EXTRUSION PRODUCTION LINES**

Moscow ELEKTROTEKHNIKA in Russian No 11, Nov 86 (manuscript received 5 May 85)  
pp 60-62

[Article by A.Ya. Gimelbrant, candidate of technical sciences and  
B.F. Saburenko, engineer, Sredazkabel Central Asia Cable Production  
Association, Scientific Research, Planning, Design and Process Engineering  
Institute for Cables]

[Abstract] The geometry of the insulation cover formed during the operation of an extrusion line is a function of several factors, including the rheological properties of the plastic, thermal conditions, quality of system drive operation and the control systems, etc. Since vibrations are produced by various imperfections in the system equipment, it is possible to make a spectral analysis of such vibrations and compare them with a standard specification value for the particular equipment assembly (such as an extruder drive, dispensing and take-up drums, tensioning assemblies). This paper describes the use of a real-time microcomputer spectrum analyzer to the trouble-shooting of an extrusion system producing cable from a multi-wire blank (diameter of 1.5 mm) with a polyethylene insulation diameter of  $7.1 \pm 0.6$  mm fabricated at a draw speed of 0.7 m/s and an extruder screw rotation rate of 1 r.p.m. The analyzer resolution of 0.0083 Hz enabled a detailed analysis showing that the take-up drum had the greatest impact on product diameter. The application of a microcomputer to extrusion line diagnosis is effective; the feasibility of the hardware and software implementation of the method demonstrated here makes it possible to duplicate these results in the cable industry. Figures 3; references: 6 Russian.

8225/9835

CSO: 1860/75

LIMITATION OF SWITCHING AND LIGHTNING VOLTAGE SURGES BY SINGLE-COLUMN  
NONLINEAR LIMITERS OF VOLTAGE SURGES

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received 21 Oct 85)  
pp 2-6

[Article by G.N. Aleksandrov, doctor of technical sciences, I.M. Bogatenkov,  
candidate of technical sciences, G.A. Guseynov, engineer, G.A. Yevdokunin,  
candidate of technical sciences and V.Z. Trifonov, engineer]

[Abstract] The article considers problems of limiting voltage surges with  
the aid of nonlinear limiters of voltage surges with a single-column design,  
distributed along a power transmission line. Calculated data are presented  
with respect to the operational reliability of the limiters in the case of  
their application to lines with a voltage of 110 kilovolts and above.  
Limiters of voltages at substations are considered. Experimental models  
of single-column limiters of voltage surges have been successfully used for  
four years in the Leningrad Regional Energy Control System (Lenenergo) on a  
110 kilovolt overhead line, and for a longer period on a 330 kilovolt over-  
head line. Figures 3; references 8: 7 Russian, 1 Western.

6415/9835  
CSO: 1860/73

PROBLEMS OF CREATION AND INTRODUCTION OF VACUUM SWITCHES FOR 6-10 KILOVOLT  
VOLTAGE

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received  
24 May 85) pp 9-11

[Article by V.A. Kotlyarchuk, candidate of technical sciences, Krasnoyarsk  
Institute of Nonferrous Metals imeni M.I. Kalinin]

[Abstract] An analysis is made of switching operations and the service life  
of vacuum switches in terms of rated currents. It is concluded that special  
feeder switches should be created and that operational (as distinguished  
from protective) switchgear consisting of oil switches should be replaced  
by vacuum switches. It is necessary to take into account the special  
conditions affecting industrial power use especially in the case of mining  
machinery and to phase in the improved switches over periods of time which  
optimize the economic lifespan of the equipment. References: 6 Russian.

6415/9835  
CSO: 1860/73

**MATHEMATICAL SIMULATION OF SWITCHING-OFF AN ARC IN AN EXPLOSIVE ARC-CONTROL DEVICE**

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received 4 Oct 85)  
pp 11-13

[Article by V.L. Korolkov, candidate of technical sciences, S.V. Sorokin and Ye.V. Tarasov, engineers]

[Abstract] The development of super high-speed explosive arc-suppressing devices for industrial electrical networks makes it possible to increase the reliability of protection of the latter from emergency regimes, as well as to improve their operating characteristics. At the design stage of such devices, the development of methods for mathematical modeling of the process of switching-off is of great value. This makes it possible to reduce sharply the volume of expensive experimental investigations. The power form of connection between the characteristic parameters of the Kassi-Meyer equation analyzed in a 1980 Australian paper and the resistance of an arc, as well as the range of existence of these parameters is determined. This permits orientation before choosing the initial conditions. Figures 2; references 5: 4 Russian, 1 Western.

6415/9835  
CSO: 1860/73

**USSR PRACTICE WITH RESPECT TO DESIGNING AND CHOICE OF INSULATION FOR CONTAMINATED AREAS**

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received 14 Jan 84)  
pp 23-26

[Article by Candidates in Technical Sciences Ye.I. Ostarenko, V.V. Godulyan, S.D. Merkhalev, and Ye.A. Solomonik]

[Abstract] The basic principles for choosing electric power line insulation for areas with various conditions of contamination are considered. The following concepts are discussed in some detail: 1) Criteria which characterize the conditions of operation of insulation; 2) Normalized dimensions of insulation of overhead transmission lines and open switch-gear according to the degree of pollution of the atmosphere; 3) Coefficient of effectiveness of employing a length of leakage path; and 4) Test of insulated construction by high voltage. It is proposed to extend testing in contaminated conditions to electrical equipment of other types and to insulator chains. Figures 2; references 9: 8 Russian, 1 Western.

6415/9835  
CSO: 1860/73

DESIGN OF VIBRATION-PROTECTING CONSTRUCTION OF RECTANGULAR INDUCTORS

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received 4 Oct 85)  
pp 34-37

[Article by L.S. Zimin, candidate of technical sciences, Kuybyshev  
Polytechnical Institute]

[Abstract] A procedure for calculating vibration and noise in an inductor-metal system and a means for creating vibration-protection of inductors are described. Other conditions being equal, vibration and noise of a rectangular inductor increases during heating of nonmagnetic metals with low resistivity, as well as during reduction of the current frequency. Less vibration and noise of projected units, in part of an inductor with the same thicknesses and material of the vibration-protecting jackets, correspond to a smaller cross section of the rectangular billet being heated. Optimization of the construction of an inductor makes it possible under real conditions to obtain gains with respect to rigidity with conservation of mass, or similar gains with respect to mass with conservation of rigidity, amounting to a factor of 1.5-1.8.

6415/9835  
CSO: 1860/73

UDC 621.365.52.001.4

INDUCTION HEATING OF HOLLOW CYLINDERS WITH INTERNAL MAGNETIC CIRCUIT

Moscow ELEKTROTEKHNIKA in Russian No 9, Sep 86 (manuscript received 4 Oct 85)  
pp 32-34

[Article by V.A. Bukanin, candidate of technical sciences, and V.S. Nemkov, doctor of technical sciences, professor, All-Union Scientific Research Institute of Electrothermal Equipment]

[Abstract] The fringe effect is investigated of hollow cylinders with an internal magnetic circuit during induction heating at various current frequencies. The investigation was conducted with: 1) The assistance of an integral numerical method realized in the SUGRAN (roman alphabet) program; and 2) Physical modeling on a mock-up of the cylinder. It is shown that it is possible to use an internal magnetic circuit efficiently in many technological processes of high-speed induction heating. For economical and high-grade heating, observance of determined conditions is necessary, taking into account the thickness of the wall of the tube, the penetration of current, and the loading in the inductor.

6415/9835  
CSO: 1860/73



UDC 538.56:519.25

**LIGHT BEAM PROPAGATION IN MEDIUM OF LARGE CORRELATED BLACK DISKS**

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received 4 Feb 85) pp 913-920

[Article by Yu.N. Barabanenkov and M.I. Kalinin]

[Abstract] The passage of light through a statistical ensemble of scattering objects densely packed in space poses a central theoretical problem in optics in that the impact of the correlations between the positions of the scattering objects must be taken into account, including the high order correlations and their influence on multiple scattering of the light. If the size of the scattering objects is large as compared to the wavelength, model analysis can produce an asymptotically precise picture of the propagation phenomenon. This paper models the propagating and scattering medium as a randomly arranged, optically rigid set of circular scattering objects. Only the shadow-forming component of the field scattering at an individual scatterer is considered. The resulting model (consisting of black disks whose planes are perpendicular to the axis of light beam propagation) is used in the analysis that considers all orders of cross-correlations of the disks without any constraint on their density in space. A parabolic equation is used to show that when the disks are delta-correlated along the propagation path, the statistical parameters of the wave field are calculated exactly in two ways: 1) By means of a Markov random process approximation; 2) By a single group approximation. It is shown that a single layer of nonoverlapping disks is less transparent than a system of independent disks. The purely theoretical analysis adduces neither numerical examples nor design applications. The authors are grateful to the participants of the S.N. Rytov Seminar for the discussion of the results. Figures 1; references 16: 15 Russian, 1 Western (in Russian translation).

8225/9835  
CSO: 1860/42



LIGHT SHIFTS OF  $^{87}\text{Rb}$  DURING LASER PUMPING

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 8, Aug 86 (manuscript received 12 Jul 85) pp 969-971

[Article by L.A. Budkin, A.A. Lyalyaskin, M.N. Penenkov, A.I. Pikhteleev,  
S.L. Puzanov and S.I. Selivanov]

[Abstract] Since the use of a semiconductor laser as a pump for rubidium frequency standards requires that the frequency standard characteristics be well defined as a function of the pumping parameters, this paper reports on laser pumping using  $^{87}\text{Rb}$  D<sub>1</sub> line and the observance of the light frequency shift. A 3 mW Ga Al As laser at about 8,000 Å in a thermostatically controlled container that maintained the laser heat sink constant with  $5 \cdot 10^{-3}$  K over 10 s was used as the pumping source. The collimated laser light was beamed into a microwave cavity containing an absorption cell filled with  $^{87}\text{Rb}$  vapor and Ar as a buffer at an overall pressure of 1 torr. The cavity was driven by an FM signal with a center frequency of 6.834 GHz. The resulting output signal was recorded by a photodetector and used to stabilize the frequency of a crystal oscillator for the measurement of the light frequency shift. The experimentally and theoretically derived curves for the shifts (between about -30 and + 30 Hz) are plotted as a function of the laser frequency. Satisfactory agreement is noted, though the slight disparity in the size of the light frequency shift is apparently explained by the fact that the laser beam absorption over the length of the cell was not considered in the theoretical calculations. When using  $^{87}\text{Rb}$  for microwave frequency stabilization, the impact of possible fluctuations in the laser emission spectrum on the position of the zero light shift point must be considered. The  $5^2\text{S}_{1/2}F = 1-5^2\text{P}_{1/2}$  transition is preferable from this viewpoint. Figures 3; references 7: 5 Russian, 2 Western.

8225/9835

CSO: 1860/42

## RANK DETECTION OF OPTICAL SIGNAL ON BASIS OF CHANGE IN SCALE OF DISTRIBUTION FUNCTION

Moscow RADIOTEKHNIKA in Russian No 9, Sep 86 (manuscript received 5 Dec 85)  
pp 90-92

[Article by A.P. Stepin and E.V. Borisov]

[Abstract] A simple algorithm of processing the rank vector for detection of optical signals, specifically weak coherent optical signals, is constructed on the basis of change in the scale of the sample distribution function and assuming a Poisson distribution of interference noise. A low signal level allows linearization of the likelihood ratio:  $T(R,S) = 1 + S[\partial T(R,S)/\partial S]$ . The coefficient of the first derivative,  $S$ , is selected as the resolving statistic and compared with the threshold statistic  $g_{S_0}$ . Both false-alarm

probability and probability of detection are calculated accordingly. The structure of such a rank detector, with a photodetector at the input and a resolver at the output, is simpler than that of the optimum detector. Figures 1; references 6: 4 Russian, 2 Western (in Russian translation).

2415/9835  
CSO: 1860/68

## GENERAL METHOD OF SYNTHESIZING BINARY MULTILAYER OPTICAL COATINGS

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA  
in Russian Vol 27, No 5, Sep-Oct 86 (manuscript received 5 Jun 85) pp 21-26

[Article by A.G. Sveshnikov, Sh.A. Furman, A.V. Tikhonravov, and S.A. Yanshin,  
Department of Mathematics, Moscow University]

[Abstract] Variational calculus is applied to the problem of synthesizing multilayer optical coatings, specifically binary ones with all odd layers made of one material with a given refractive index and all even layers made of another material with a given refractive index. The energy transmission coefficient  $T(\lambda)$  of the coating, a function of the wavelength  $\lambda$ , is uniquely determined by the thickness vector  $X = \{d_1, d_2, \dots, d_N\}$  and the refractive index of the substrate, layers being numbered from the one on the substrate (1) up to the one with a free surface ( $N$ ). The problem is formulated as an optimization problem: to minimize the error functional

$$F = \sum_{k=1}^M v_k [T(\lambda_k) - \bar{T}(\lambda_k)]^2 \quad (v_k - \text{weight coefficients for waves with TE and}$$

TM polarization within the  $\lambda_1, \dots, \lambda_N$  range of spectrum. In the first step of

its solution values of this functional are scanned, without an initial approximation, on a grid of X-vectors in the parameters space. After K of the X-vectors corresponding to the lowest values of that functional have been selected,  $T(\lambda)$  is calculated for each, most efficiently according to the principle of base matrices. In the second step of the solution those  $X_k$  vectors are used as initial approximations for minimization of the functional F by gradient methods, the algorithm of steepest descent followed by the algorithm of conjugate directions, which yields K local minima. From among those is then selected the lowest one as solution to the problem of synthesis. The procedure has been programmed on a BESM-6 high-speed computer. It is demonstrated on the synthesis of 7-layer, 10-layer, 12-layer wideband transparent coatings made of two materials with refractive indexes 1.46 and 1.96 respectively on various substrates (refractive index 1.46, 1.51, 1.61, 1.64) in air. Calculations were made assuming normal incidence of light. Figures 2; tables 1; references: 4 Russian.

2415/9835  
CSO: 1860/69

UDC 621.375.826.3.082.63.001.4

#### DIFFERENTIATING CALORIMETER FOR INDUSTRIAL CO<sub>2</sub> LASER

Moscow ELEKTROTEKHNICA in Russian No 9, Sep 86 (manuscript received 8 Jul 85)  
pp 37-39

[Article by K.E. Lint, A.Ya. Britva, and V.A. Myakushin, engineers,  
Special Design Office, Siberian Electrothermal Production Association]

[Abstract] The differentiating calorimeter described was used for a year for measurement of the radiated power of an industrial CO<sub>2</sub>-laser with a power of 1.5 kilowatt. At failure the operating time of the calorimeter amounted to 200 hours. Tests of this calorimeter demonstrated its high reliability and simplicity of operation. Figures 2; references: 2 Russian.

6415/9835  
CSO: 1860/73

## WORKING STANDARD FOR AVERAGE UNIT POWER CALIBRATION OF LASER BEAM AT WAVELENGTHS OF 0.48 AND 10.6 MICROMETERS

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 15-18

[Article by I.N. Govor, A.V. Kubarev and V.V. Ozolin]

[Abstract] A working standard for power calibration of lasers at 0.48, 0.63 and 10.6 micrometers measures the beam power by comparing it to the power generated by a controlled electric current. The measurement transducer has a dynamic range of 0.1 to 1.0 W and employs a calorimeter for comparing the laser beam power being tested to the calibrated current power. The system uses an argon LGN-404A and a CO<sub>2</sub> LGN-703 industrial lasers with stabilized output power levels. Considerable attention is devoted to a discussion of a unique, two-stage comparator design used in the system and the analysis of its equivalent electrical circuit in order to ascertain all possible sources of error. The comparator allows for independent calibration during operation. The system incorporates an Elektronika DZ-28 minicomputer with a taped program for computing the calibration parameters of the comparator, the absorbed and incident beam power as well as the procedural error of the systems. Results of certification testing of the standard are summarized in a table showing that it conforms to the requirements of GOST 8.275-78. The mean square error in the reproduction and transmission of a unit power level is less than  $2 \cdot 10^{-3}$  at all wavelengths. The maximum differences in the power levels of a stabilized He-Ne laser measured with the standard meter did not exceed 0.008%. Figures 3; tables 2; references 10: 7 Russian, 3 Western (1 in Russian translation).

8225/9835

CSO: 1860/44

## LOW BACKGROUND LEVEL SEMICONDUCTOR SPECTROMETER

Moscow IZMERITELNAYA TEKHNIKA in Russian No 9, Sep 86 pp 59-61

[Article by Yu.G. Zdesenko, A.B. Kostezh, B.N. Kropivnyanskiy, V.N. Kuts, I.A. Mytsyk and A.S. Nikolayko]

[Abstract] The highest sensitivity attained in a semiconductor spectrometer up to now was reached by a group at Milan University (C. Liguori, et al.) based on the study of the double beta decay of <sup>76</sup>Ge. This paper details the design and operation of a similar low background level spectrometer with a germanium-lithium detector. This Soviet spectrometer was based on experience with low background level measurements while studying the double beta decay of <sup>130</sup>Te, <sup>96</sup>Zr and <sup>100</sup>Mo and was built for the purpose of working out a procedure for researching the double beta decay of <sup>76</sup>Ge and measuring the

radioactive contamination of structural materials used in low background level measurement systems. The coaxial germanium-lithium detector is 34 mm in diameter and 38 mm long, has an energy resolution of 2.9 keV at the 1,332 keV line and is housed in a cryostat fabricated from highly pure copper and titanium. The cryostat with the detector is shielded by a multilayer sandwich of mercury, cadmium, lead and polyethylene. The actual energy resolution of the detector is degraded from 2.9 to 3.8 keV (with respect to the  $^{60}\text{Co}$  1,332 keV line) because of the use of a 400 mm long signal line connecting the preamplifier to the semiconductor detector. Four different background spectra of the detector are graphed for different conditions at energies between 200 and 3,000 keV: 1) In the laboratory without any shielding; 2) With lead shielding; 3) With additional mercury, cadmium and polyethylene shielding and 4) With the full shield. The average background intensity in 1,400 to 1,500 and 2,000 to 2,100 keV ranges is  $2.9 \pm 0.04 \cdot 10^{-2}$  and  $1.8 \pm 0.03 \cdot 10^{-2}$  readings/(hr·keV), respectively. The data presented here show that the background characteristics of this detector operating at the earth's surface are close to the parameters of the facility in the tunnel under Mont Blanc. The fact that the intensity of the annihilation lines in the spectrum of this detector is 10 times greater than the intensity of the remaining peaks is evidence of the crucial contribution of cosmic radiation to the background level observed and makes it possible to figure on a further reduction in the level when the system is housed in an underground laboratory. Figures 2; references 6: 2 Russian, 4 Western.

8225/9835

CSO: 1860/44



UDC 621.328.8

DYNAMIC CHARACTERISTICS OF REGISTER ON GaAs CHARGE-COUPLED DEVICE OVER  
77-600 K TEMPERATURE RANGE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received 29 Jul 85) pp 42-46

[Article by A.I. Prokopyev]

[Abstract] The transient process of charge transfer in a register built on a GaAs charge-coupled device is evaluated, for a determination of the maximum attainable speed over the 77-600 K temperature range. The analysis is based on a nonlinear equation of continuity, in accordance with the classical Einstein relation between charge mobility and diffusion coefficient, with the drift velocity depending on the impurity concentration as well as on the electric field intensity and the temperature. Computer calculations were made for a 3-phase device with buried channel and 5  $\mu\text{m}$  long Schottky-barrier gates, a 2  $\mu\text{m}$  thick epitaxial n-layer on a p-layer substrate, and a 1  $\mu\text{m}$  clearance between gates, n-layer and p-layer doped to impurity concentrations of  $10^{16} \text{ cm}^{-3}$  and  $10^{15} \text{ cm}^{-3}$  respectively. These calculations have yielded the charge transfer inefficiency as a function of the transfer time, depending on the clock voltage between emitter and collector. They have also yielded the dependence of the maximum attainable clock frequency  $f_c = 1/3t_{99.99\%}$  on the clock voltage. The results of analogous calculations made for a comparable Si device reveal the advantage of a GaAs device in terms of a higher speed over an upward wider temperature range, especially at low clock voltages ( $<10 \text{ V}$ ). The speed of such a device at low temperatures (77-225 K) can be increased by application of a strong electrical fringe field. Figures 3; references 9: 3 Russian, 6 Western.

2415/9835

CSO: 1860/74

SELECTING METHOD OF  $I^2L$  SCALING FOR LARGE-SCALE INTEGRATION

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received 15 Jul 85) pp 64-65

[Article by B.G. Konoplev and A.I. Astakhov]

[Abstract] Scaling of  $I^2L$  LSI structures is more difficult than scaling of MOS LSI structures, not only because the voltage across a forward-biased p-n junction and thus the equal to it supply voltage cannot be reduced but also because nonproportional scaling is required in some areas. A scaling law must therefore be selected, and the corresponding algorithm constructed, most suitable for a given device. This has been done on a computer, with the device characteristics after scaling calculated according to the MASSHTAB (SCALE) program, including allowances for dimensional changes in the course of photolithography and impurity diffusion. The basic program is based on a quasi-two-dimensional mathematical model, but has been modified into a three-dimensional one. In the case of an epitaxial-planar 4-collector integrated n-p-n-p-n-p transistor with horizontal injection, for instance, two-dimensional X,Y scaling down is found to decrease the switching energy and the current transfer ratio while only slightly shortening the minimum delay time. Three-dimensional and thus also vertical scaling down, all geometrical dimensions proportional to  $K_M$  and the impurity concentration inversely proportional to  $K_M^2$ , also decreases the switching energy but increases the current transfer ratio and shortens the minimum delay time appreciably. Figures 1; references 4: 2 Russian, 2 Western.

2415/9835

CSO: 1860/74

UDC 681.3.06.621.382.3:519.95

## GENERALIZED ELECTRIC-LOGIC MACROMODELS FOR COMPUTER-AIDED DESIGN OF LARGE-SCALE-INTEGRATED CIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received after revision 16 Dec 85) pp 70-72

[Article by V.M. Bondarenko, A.V. Maranov, and I.V. Makarov]

[Abstract] The system KomPAS-SM, developed for efficient and rapid computer-aided analysis of LSI fragments, contains digital electric-logic macromodels built with elementary diodes. It is shown, as an example, how these macromodels can be used for synthesizing a TTL 2-NAND gate so as to reproduce a given output voltage characteristic. A major drawback of such macromodels is that they require storage of lookup tables in the computer

memory and thus an almost unlimited number of experiments for full description of a fragment. Multidimensional approximation does not simplify the problem, owing to the very large number of influencing factors, but regression equations relating the output parameter to the influencing factors will. The output parameter is generally described by a polynomial of  $n$ -th degree,  $n = 3$  in the specific case shown here. The calculation of the parameters of generalized electric-logic macromodels has been programmed on an SM-4 computer for analysis of approximately 1000 digital LSI fragments. Figures 1; references 8: 6 Russian, 2 Western (1 in Russian translation).

2415/9835  
CSO: 1860/74

UDC 621.382.82.001

#### DIALOG SYSTEM FOR PARAMETRIC IDENTIFICATION OF MODELS OF INTEGRATED-CIRCUIT ELEMENTS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 29, No 9, Sep 86 (manuscript received after revision 26 Nov 85) pp 77-79

[Article by S.G. Rusakov and S.L. Ulyanov]

[Abstract] Solving the problem of closest fit between experimental and theoretical performance characteristics, usually done for identifying the parameters of a model of a semiconductor device, can be done for identifying the parameters of models of IC elements. The computer-aided analysis is most expediently performed in the dialog mode. The software of the ARIS-PIM system developed for this purpose contains a monitor, a library of optimization algorithms, a library of IC elements, programs for processing input data, and programs for graphically or alphanumerically displaying output data. The procedure is based on the key word commands: CHANGE, SCAN, START, GRAPH, DIAGRAM, ASSIST (with reference data). The results of such an analysis are demonstrated on the current-voltage characteristic of an MOS transistor for either digital or analog circuits, before and after identification of parameters. Analysis of a bipolar transistor is based on the Ebers-Moll model, taking into account the Early effect and dependence of the current gain on the collector current. Methods of zeroth-order, first-order, second-order optimization included in the library are the method of deformed polyhedron, the Powell method, the Davidov-Fletcher-Powell method, the Broyden method, and minimization of gully functions by numerical integration of rigid control systems. Figures 2; references 8: 7 Russian, 1 Western (in Russian translation).

2415/9835  
CSO: 1860/74

## FROM CIRCUIT DESIGN ELECTRONICS TO FUNCTIONAL LEVEL DESIGN

Moscow RADIO in Russian No 9, Sep 86 pp 12-14

[Article by Ya. Fedotov, professor, doctor of technical sciences]

[Abstract] The design methodology comprising the basis for all electronics up to the present can be called circuit design, since the individual active and passive components are connected together by conductors to form an electrical circuit. However, the increasing level of integration of semiconductor circuits encounters inherent physical constraints that are insuperable: the minimal topological size of such circuits (presently down to about 1 micrometer) is limited by a number of unfavorable phenomena (charge migration, joule heating, etc.). Such physical limitations are a reflection of the larger conceptual constraint on sequential information processing at the heart of current design procedures. The extraordinary volume of information that will have to be handled in the future requires a fundamentally different approach to the conceptualization of electronic systems: they are to be modeled on the human pattern recognition capability. In this case, entire data arrays are compared in a nearly parallel process. The primary information medium in such a functional approach is a so-called "dynamic inhomogeneity", defined as a volume bounded in a homogeneous medium and produced by reversible physical processes. The medium contains no such inhomogeneities in the equilibrium state; they only arise with exposure to various external physical inputs (electric, magnetic, electromagnetic fields, mechanical perturbations, etc.). While devices have now been developed in functional electronics that utilize one type of dynamic inhomogeneity, the time has come for the integration of various physical effects and the primary processing of large information arrays in a single device. This general discussion provides neither numerical nor design examples.

8225/9835

CSO: 1860/46

## DEVELOPMENT OF MICROELECTRONICS IN GERMAN DEMOCRATIC REPUBLIC

Moscow RADIO in Russian No 9, Sep 86 pp 15-16

[Article by Egon Winkelmann, GDR ambassador extraordinary and plenipotentiary to the USSR]

[Abstract] Qualitative factors relating to GDR economic growth continue to reflect the progress of socialism, especially in labor productivity and the electronics sector supporting it (more than 90% of the GNP increase is due to the improvement of labor productivity). This paper is a brief outline of the development of the GDR microelectronics industry since 1976, including projections through 1990. It is planned that electronic component production will rise from 30.5 billion marks in 1985 to 42 billion in 1990. The application of microelectronic hardware will boost labor productivity by 25%,



reduce raw materials consumption by 25 to 30%, power consumption by 30% and curtail the cost of equipment repairs and operation by 20 to 30%. The product mix of IC's will be expanded significantly by 1990 through the introduction of new baseline technologies: the annual increase in active component production will be 26%, while the growth in passive device output will be 12% annually. Scientific and engineering research will concentrate on 16 and 32-bit microprocessors, optoelectronics for lightguide engineering, optoelectronic and micromechanical transducers, color displays and printed circuit board mounted components. The direct relationships established between the GDR and Soviet enterprises are crucial to the implementation of the microelectronic development program that has been planned: Carl Zeiss Jena, Mikroelektronik, Electronic Components and Robotron combines have direct ties to scientific and industrial associations in Moscow, Leningrad, Kiev and other industrial centers in the USSR. Deliveries of IC's from the USSR supporting the instrument making program of the GDR grew by 100 times between 1977 and 1986. The GDR continues to increase shipments of special industrial process equipment for microelectronic devices to the USSR. Figures 3.

8225/9835  
CSO: 1860/46

UDC 681.14

#### DECOMPOSITION METHOD OF SYNTHESIZING TOPOLOGY OF MICROELECTRONIC ASSEMBLIES

Leningrad IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: PRIBOROSTROYENIYE  
in Russian Vol 29, No 10, Oct 86 (manuscript received 11 Apr 84) pp 55-56

[Article by A.L. Kuznetsov, Leningrad Institute of Precision Mechanics and Optics]

[Abstract] A method facilitating computer-aided design of microelectronic circuits is proposed, usual simultaneous layout of components and routing of their interconnections being replaced by decomposition of the assembly into fragments containing components joined into groups according to some rational plan and rules with the conventional layout and routing sequence applied to each "quasi-simultaneously". Connectedness or functional completeness may typically serve as criterion for grouping of components. First the internal topology of all groups is synthesized thus, then the chip dimensions are determined to accommodate those groups as well as external connections. The procedure is repeated till all such pseudo-components of the lowest rank are interconnected, depending on the grouping rule, then successively pseudocomponents of next higher ranks are all interconnected. The topology of the assembly structure is thus only partially optimized, at a certain level during each stage of the synthesis process, this being very convenient for input of data on individual fragments at any level. References: 2 Russian.

2415/9835  
CSO: 1860/63



UDC 621.371.39:534

DIFFRACTION COMPONENT OF FREQUENCY CHARACTERISTICS OF SURFACE-ACOUSTIC-WAVE DEVICES

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 9, Sep 86 (manuscript received after revision 29 Aug 85) pp 55-57

[Article by Ye.A. Nelin, I.V. Cherkashin, and I.L. Lisyanskiy]

[Abstract] Diffraction of surface acoustic waves in interdigital transducers, a major cause of distortion of their frequency characteristics, is analyzed on the simple assumption that it is the only and an additive cause. Such a transducer is treated as a transversal filter and, on this basis, a general expression is obtained for the diffractive term of its frequency characteristic. This term is then calculated explicitly for symmetric equidistant interdigital structures with uniform overlapping of electrodes, without or with apodization of the receiver transducer. Figures 3; references 5: 2 Russian, 3 Western (1 in Russian translation).

2415/9835

CSO: 1860/74

UDC 621.317

TRANSIENT PROCESSES IN ACOUSTOOPTIC SPECTRUM ANALYZERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 29, No 9, Sep 86 (manuscript received 26 Jun 85) pp 65-67

[Article by A.F. Bukhenskiy and V.N. Yakovlev]

[Abstract] Transients in an optical spectrum analyzer containing an acoustooptic light modulator with aperture period  $T$  in the entrance focal plane are evaluated, assuming that the sound wave propagates along the optical axis in the opposite direction and an optical field builds up in the exit focal plane along the space-frequency axis. The response to an input pulse signal  $U(t)$  ( $0 \leq t - \tau_s, \tau_s < T$ ) is calculated separately for time

intervals  $0 \leq t \leq \tau_s$ ,  $\tau_s \leq t \leq T$ ,  $T < t \leq \tau_s + T$  in terms of amplitude and time-frequency distributions as functions of space frequency  $\omega_x$  and time  $t$ . The results are presented in the form  $\alpha, \omega_x, t$  and  $\omega, \omega_x, t$  surfaces respectively, in the corresponding three-dimensional Cartesian systems of coordinates. Figures 1; references: 1 Western.

2415/9835  
CSO: 1860/74

UDC 517.958:535.4

SCALAR PROBLEM OF DIFFRACTION BY BODY NEAR PLANE AND ITS SOLUTION BY METHOD OF ANTENNA POTENTIAL

Moscow VESTNIK VOSKOYSKOGO UNIVERSITETA, SERIYA 3: FIZIKA, ASTRONOMIYA  
in Russian Vol 27, No 5, Sep-Oct 86 (manuscript received 25 Nov 85)  
pp 74-76

[Article by V.V. Kravtsov and P.K. Senatorov, Department of Mathematics,  
Moscow University]

[Abstract] The problem of diffraction is formulated for a scalar wave and a body with a surface closing on itself near the plane boundary of the half-space containing that body. The problem reduces to a three-dimensional boundary-value problem of scattering for the Helmholtz wave equation, with appropriate boundary conditions at that boundary plane, at the body surface, and at infinity. Assuming that this problem has a unique classical solution, its solution is sought in the form of the antenna potential on the basis of a convergence theorem for the latter. The unknown density of antenna potential is calculated by solving the appropriate Euler equation, in this case a Fredholm integral equation of the first kind, for the corresponding convergence functional. Regularization by the Tikhonov method yields the minimum of that functional and the density of antenna potential can be found as the extremum of the smoothing functional, the Euler equation for the latter being an integro-differential equation of the second kind solvable by standard numerical methods after reduction to a system of linear algebraic equations with a square matrix. Calculations at 11 points for a sphere and for an ellipsoid at various distances from the plane have yielded fairly precise diffraction patterns for plane and spherical waves incident normally or at  $45^\circ$  to the plane, with Dirichlet boundary conditions at the body surface and at the plane or with Dirichlet boundary condition at the body surface and Neumann boundary condition at the plane. Figures 2; references: 1 Russian.

2415/9835  
CSO: 1860/69

SELF-SYNCHRONIZATION OF NONLINEAR ACOUSTIC OSCILLATORS

Gorkiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 29, No 9, Sep 86 pp 1129-1136

[Article by Yu.A. Kobelev, L.A. Ostrovskiy, and I.A. Soustova, Institute  
of Applied Physics, USSR Academy of Sciences]

[Abstract] An array of mechanical oscillators and amplification of the acoustic field in the surrounding fluid medium are considered. Possibility of its self-synchronization is examined in the case of a liquid-gas mixture in which the gas bubbles perform free monopole oscillations with phase uniformly distributed over the  $0-2\pi$  range. Calculations are made for such oscillators with finite lifetime from formation to collapse and for oscillations sustained by repetitive interaction pulses at constant frequency but with randomly varying momentum. Stochastic instability owing to overlap of nonlinear resonances are disregarded in the analysis. Amplification of a coherent field is found to be possible in both cases, despite losses in such oscillators, and its magnitude is evaluated. The authors thank K.A. Gorshkov and V.K. Yulpatov for valuable discussions. Figures 1; references 7: 6 Russian, 1 Western (in Russian translation).

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CSO: 1860/64

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August 28, 1987

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